

SOCIAL SCIENCES

Room

PUBLIC LIBRARY

AUG 11 1939

DETROIT

Public Health Reports

VOLUME 54

JULY 21, 1939

NUMBER 29

IN THIS ISSUE

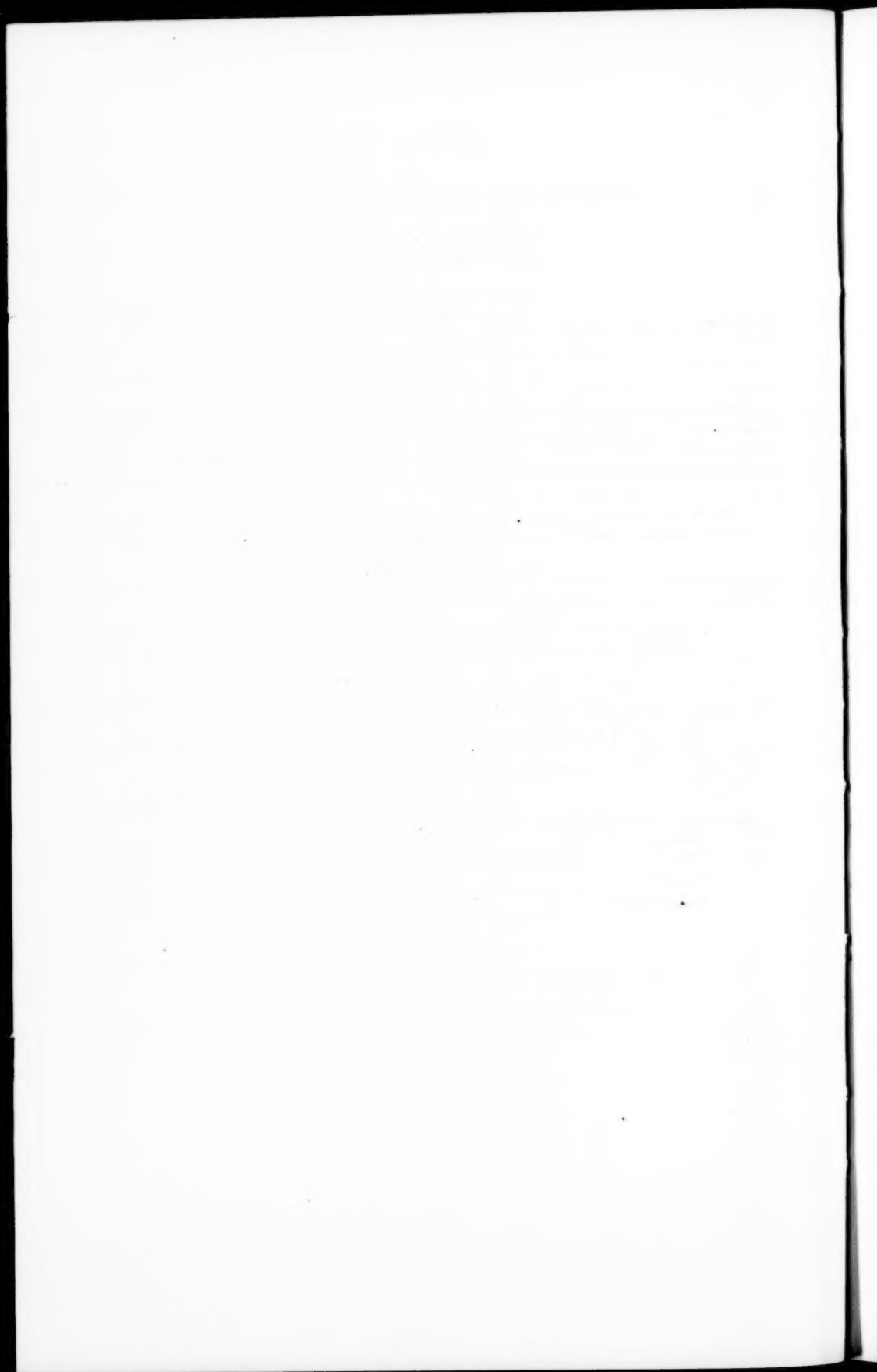
Disabling Illness Among Workers in the Soap
Industry, 1930-34

Antibacterial Action of Arsenic, Sulfur, and
Nitro Compounds

Characteristics of Strains of Typhus Fever
Found in Mexico

Distribution of *O. parkeri* and Infection With
Relapsing Fever





Public Health Reports

Vol. 54 • JULY 21, 1939 • No. 29

PREVALENCE OF POLIOMYELITIS

According to reports received from the State health authorities, a total of 143 cases of poliomyelitis was reported in the United States for the week ended July 15, 1939, as compared with 84 cases for the preceding week and with a 5-year median for the current week of 191 cases. Although a considerable increase is shown for the current week, the number of cases reported was only about 75 percent of the expectancy based on the median for the 5 preceding years.

There was no change in the situation in South Carolina, where 20 cases were reported (the same as for the preceding week), while North Carolina, Georgia, and Florida showed decreases. The number of cases in the East North Central States increased from 4 to 18, and in the West North Central group from none to 10. Nineteen States reported no cases. California reported 45 cases, as compared with 18 for the week ended July 8, but of these cases Los Angeles reported only 5 and San Francisco 1. Information regarding the distribution of the cases by other localities is not available.

DISABLING MORBIDITY AMONG EMPLOYEES IN THE SOAP INDUSTRY, 1930-34,¹ INCLUSIVE

By HUGH P. BRINTON, *Associate Statistician* and HARRY E. SEIFERT, *Assistant Public Health Engineer, United States Public Health Service*

The present report dealing with sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer among workers in the soap industry covers the period 1930-34 and is derived from data transcribed from the sick benefit organization records of 10,833 members who were employed in 36 establishments. The basic data with respect to months of membership, cases and days of dis-

¹ From the Division of Industrial Hygiene, National Institute of Health, Washington, D. C. The supporting data of this report for the period January 1, 1930, to December 31, 1934, are drawn from material collected by the Occupational Morbidity and Mortality Study of the National Health Survey. The study was made possible by a grant from the Works Progress Administration in 1935. Bibliographic information concerning the reports prepared thus far is included in the list of references (1-5).

Readers interested in a description of soap making, useful in determining, among other things, the duties connected with the different occupations may consult reference 7.

Acknowledgment is made to Dr. W. M. Gafner for his assistance in the preparation of this paper.

ability, and deaths are summarized in the following table. It will be observed that the months of membership total 389,399. On the basis of continuous membership during the entire study period of 60 months, this would mean that there were at least 6,490 employees, but actually there were 10,833 employees, which results in an average membership of 36 months instead of 60 for the 5 years. Since the months of membership for the employees other than white are too small to be used for statistical purposes, the analysis will be based on the experience of white males and females.

| Color and sex | Number of months of membership | Number of cases of disability | Number of days of disability | Number of deaths |
|---------------|--------------------------------|-------------------------------|------------------------------|------------------|
| Total..... | 389,399 | 2,565 | 90,772 | 89 |
| White: | | | | |
| Male..... | 336,015 | 2,129 | 75,490 | 84 |
| Female..... | 52,490 | 429 | 14,935 | 5 |
| Colored: | | | | |
| Male..... | 668 | 7 | 256 | |
| Unknown..... | 217 | | 91 | |

Limitations of the data.—Membership in the sick benefit organization is compulsory, but excludes employees with initial salaries of \$3,600 per year or over. There are no age limits for applicants for membership, but a physical examination is required. Benefits are refused for disabilities connected with the improper use of stimulants or narcotics, "immoral practices," venereal diseases, voluntary self-injury, unlawful acts, fighting, and maternity. There is a *waiting period* of 7 days, which means that payments are not made for the first 7 days of disability. Payments amounting to two-thirds of the weekly wages are paid for a *maximum benefit period* of 52 weeks in any one year in the event of one or more disabilities. Thereafter reduced payments are continuous.

The analysis is based on only those disabilities that occurred while a worker was a member of the sick benefit organization and these disabilities, furthermore, must have been eligible for benefits.

Since the various sick benefit organizations furnishing data to the Occupational Morbidity and Mortality Study had waiting periods and maximum benefit periods of different durations, certain principles were set down in order that the data for all organizations would be comparable. Thus, a standard waiting period of 7 days was adopted, since all of the cooperating sick benefit organizations considered in this series of reports have a waiting period of 7 days or less.

With respect to the standardization of the maximum benefit period, on the other hand, disabilities or cases which had a duration of 91 calendar days or longer were arbitrarily terminated at 91 days. Only disabilities which began during the study period and lasted 8 calendar days or longer were considered as cases. Disabilities which began before the study period started and lasted 8 calendar days or longer during the study period were not considered as cases, but all days of disability occurring during the study period were considered as days disabled. Known duration cases are those that began and terminated in recovery or death during the study period. Ended cases for calculating fatality rates consist of all disabilities which terminated either in death or recovery during the study period and disabilities which ended in death before the expiration of the waiting period.

Occupational grouping.—Since the number of months of membership for specific occupations was too small for separate analysis the occupations were arranged

into 11 groups for white male workers and into 3 groups for white female workers, as shown in table 1. For both sexes the group of office workers includes members working in similar environments who are presumably not subjected to the exposures in the plant. Process operators, males only, include mainly semiskilled workers who are engaged in making soap; although a large variety of materials is used, for example, fats, oils, lye, sal soda, glycerine, and other products, normally these workers are not exposed to such materials, since most of the processes are enclosed. The group consisting of soap handlers and process laborers is subjected to strenuous work. Soap handlers prepare the finished soap for the wrappers and packers; process laborers include equipment cleaners, as well as workers who supply the different materials required in processing, and general laborers who assist the process operators. Packing machine operators include both male and female workers who handle the finished soap. Warehouse laborers do strenuous work and are presumably not subjected to exposures in the plant. Laborers (not elsewhere classified) are unskilled workers who are not designated elsewhere in the table. This group is not homogeneous as to the type of work or exposure. Some of these laborers work inside and some outside the plant. The only characteristic which they have in common is the fact that they are unskilled. The remaining occupational groups listed in the table are self-explanatory.

TABLE 1.—*Specific occupations comprising each occupational group*

| Occupational group | Specific occupations |
|--|--|
| WHITE MALES | |
| Office workers..... | Accountants, bookkeepers, cashiers, clerks, officials, and stenographers. |
| Salesmen..... | Commercial salesmen and sales-promotion men. |
| Foremen..... | Foremen in all departments. |
| Process operators..... | Amalgamators, crutchers, dryer operators, evaporator operators, filter-press operators, furnace men, hardening-machine operators, plodders, pump operators, refiners, roll operators soap boilers, still operators, and tower operators. |
| Soap handlers and process laborers (n. e. c.) ¹ . | Carry-offs, cutters, process laborers (except packing department laborers), pull-outs, setters, slabbers, stampers, and strippers. |
| Packing-machine operators..... | Filling-machine operators, folders, packing-machine operators, sealers, and wrapping-machine operators. |
| Packing laborers..... | General laborers in the packing department, machinery cleaners, and truckers. |
| Warehouse laborers..... | Car loaders and unloaders, general warehouse laborers, stackers, and truckers. |
| Maintenance workers..... | Blacksmiths, carpenters, electricians, machinists, masons, mechanical helpers and laborers, mechanics, millwrights, oilers, painters, pipefitters and helpers, riggers and helpers, tank builders, tinner and helpers, welders and welders' helpers. |
| Laborers (n. e. c.) ¹ | Ashmen, automobile washers, boiler cleaners, coal and coke handlers, and general laborers about plant and yard. |
| All others..... | Bakers, coopers and helpers, drivers, laboratory workers, licensed engineers and firemen, office and rest-room janitors, porters, railroad firemen and engineers, truck and tractor drivers, and watchmen. |
| WHITE FEMALES | |
| Office workers..... | Bookkeepers, cashiers, clerks, office machine operators, stenographers and typists, and telephone operators. |
| Packing-machine operators..... | Filling-machine operators, sealers, wrapping- and packing-machine operators. |
| All others..... | Foreladies, janitors, laboratory workers, nurses, and restaurant help. |

¹ Not elsewhere classified.

ANALYSIS OF THE DATA

Age distribution by occupational group.—For each occupational classification the percentage of workers in each age group, and the months of membership, by age group, are shown in table 2. In addition, are given the percentage distribution by age group for gainful white

male and female workers in the United States and the distribution for gainful male and female workers in the soap industry.

TABLE 2.—Months of membership by age and sex according to occupational group, white employees in the soap industry, 1930-34, inclusive

| Occupational group | All known ages | Age in years | | | | | |
|--------------------|----------------|--------------|-------|-------|-------|-------|-------------|
| | | Under 25 | 25-34 | 35-44 | 45-54 | 55-64 | 65 and over |

| PERCENTAGE DISTRIBUTION | | | | | | | |
|---|-------|------|------|------|------|-------|------------------|
| Males | | | | | | | |
| All gainful white workers in the United States ¹ | 100.0 | 19.7 | 24.0 | 22.9 | 17.4 | 10.7 | 5.3 |
| All gainful workers in soap factories in the United States ¹ | 100.0 | 22.3 | 27.0 | 22.9 | 16.2 | 8.5 | 3.1 |
| All occupations, present report..... | 100.0 | 12.2 | 40.7 | 27.8 | 13.1 | 5.5 | .7 |
| Office workers..... | 100.0 | 23.1 | 46.8 | 20.0 | 7.7 | 2.1 | .3 |
| Salesmen..... | 100.0 | 7.6 | 47.2 | 33.8 | 8.9 | 2.4 | .1 |
| Foremen..... | 100.0 | 5.9 | 35.8 | 34.0 | 16.0 | 7.1 | 1.2 |
| Process operators..... | 100.0 | 8.4 | 41.2 | 28.8 | 16.0 | 5.2 | .4 |
| Soap handlers and process laborers..... | 100.0 | 8.6 | 44.2 | 29.3 | 13.6 | 3.3 | 1.0 |
| Packing-machine operators..... | 100.0 | 32.7 | 41.9 | 16.8 | 6.2 | 2.4 | (²) |
| Packing laborers..... | 100.0 | 17.2 | 43.9 | 23.5 | 10.1 | 5.0 | .3 |
| Warehouse laborers..... | 100.0 | 8.5 | 36.4 | 33.2 | 17.2 | 4.4 | .3 |
| Maintenance workers..... | 100.0 | 6.1 | 34.6 | 33.0 | 17.9 | 7.8 | .6 |
| Laborers (n. e. c.)..... | 100.0 | 10.2 | 32.5 | 24.9 | 19.0 | 10.9 | 2.5 |
| All others..... | 100.0 | 17.6 | 34.9 | 20.6 | 13.9 | 10.9 | 2.1 |
| Females | | | | | | | |
| All gainful white workers in the United States ¹ | 100.0 | 38.5 | 24.4 | 18.9 | 11.5 | 6.2 | 2.5 |
| All gainful workers in soap factories in the United States ¹ | 100.0 | 54.6 | 26.0 | 11.7 | 5.6 | 1.7 | .4 |
| All occupations, present report..... | 100.0 | 42.0 | 37.9 | 13.4 | 5.3 | 1.4 | (²) |
| Office workers..... | 100.0 | 40.7 | 41.5 | 11.5 | 4.7 | 1.6 | (²) |
| Packing-machine operators..... | 100.0 | 54.0 | 34.3 | 9.6 | 2.1 | ----- | ----- |
| All others..... | 100.0 | 18.2 | 29.7 | 32.1 | 16.1 | 3.9 | ----- |

| NUMBER OF MONTHS OF MEMBERSHIP | | | | | | | |
|---|---------|--------|---------|--------|--------|--------|-------|
| White males | | | | | | | |
| All occupations, present report..... | 335,550 | 40,956 | 136,556 | 93,345 | 43,951 | 18,302 | 2,440 |
| Office workers..... | 47,254 | 10,891 | 22,187 | 9,471 | 3,622 | 970 | 163 |
| Salesmen..... | 50,872 | 3,889 | 23,993 | 17,212 | 4,545 | 1,199 | 34 |
| Foremen..... | 25,526 | 1,503 | 9,131 | 8,679 | 4,094 | 1,818 | 301 |
| Process operators..... | 28,095 | 3,194 | 15,702 | 10,974 | 6,071 | 1,993 | 161 |
| Soap handlers and process laborers..... | 26,681 | 2,308 | 11,788 | 7,812 | 3,637 | 878 | 258 |
| Packing-machine operators..... | 9,758 | 3,193 | 4,092 | 1,640 | 601 | 230 | 2 |
| Packing laborers..... | 22,951 | 3,946 | 10,077 | 5,397 | 2,316 | 1,154 | 61 |
| Warehouse laborers..... | 12,912 | 1,092 | 4,695 | 4,289 | 2,223 | 574 | 39 |
| Maintenance workers..... | 51,414 | 3,134 | 17,772 | 16,963 | 9,182 | 4,026 | 337 |
| Laborers (n. e. c.)..... | 13,605 | 1,384 | 4,422 | 3,383 | 2,591 | 1,488 | 337 |
| All others..... | 30,482 | 6,422 | 12,747 | 7,525 | 5,069 | 3,972 | 747 |
| White females | | | | | | | |
| All occupations, present report..... | 52,470 | 22,050 | 19,900 | 7,032 | 2,765 | 717 | 6 |
| Office workers..... | 30,422 | 12,376 | 12,620 | 3,511 | 1,435 | 474 | 6 |
| Packing-machine operators..... | 15,795 | 8,534 | 5,422 | 1,516 | 823 | ----- | ----- |
| All others..... | 6,253 | 1,140 | 1,858 | 2,005 | 1,007 | 243 | ----- |

¹ Reference (6).

² Less than 0.1 of 1 percent.

Only in the age group 25-34 is the percentage of white male workers in this report (40.7) appreciably greater than the corresponding percentages given for the two other population groups. Summations show that the percentages of the gainful white male workers in the United States, the male workers in the soap industry and the white male workers in this study under 35 years of age are 43.7, 49.3, and 52.9, respectively. It is of interest to observe the percentage age distribution of white male office workers and of white male packing-machine operators. In the former group, 69.9 percent of the workers are under 35 years of age, while the corresponding percentage for the latter group is 74.6; these figures reflect the relatively high percentages of workers under 25 years of age. The two groups with the smallest percentage of workers under 35 years of age are foremen and maintenance workers with 41.7 and 40.7 percent, respectively.

A much larger percentage of female workers than of males are under 25 years of age, the ratio of the percentages being over 3 to 1. The percentages of workers under 35 years of age among all gainful white female workers in the United States, for female workers in the soap industry, and for white females in this study are 62.9, 80.6, and 79.9 percent, respectively. The proportion of workers in each 10-year age group after 34 years is nearly identical for gainful female workers in soap factories and white female workers covered in this report. In the occupational group of packing-machine operators 88.3 percent of the white female workers are under 35 years of age, as compared with 74.6 percent for white male workers.

Frequency of disabilities, by duration.—Table 3 shows by sex for two broad age groups the frequency of cases of disability of different durations. It will be noted that with respect to all durations the difference between the frequencies for the two age groups is very much greater among the males than among the females. Among both sexes, for the shortest durations, 8-14 days, there was a greater frequency among younger than among older persons, but for durations of 15 days and longer the cases in the older age groups showed greater frequencies, with the excess being most marked for the cases with longest duration.

At all ages and for all durations the rate for females was greater than that for males. For both age groups an increase in the length of case tended to make the position of females relatively more unfavorable. The difference between the male rate and the female rate was relatively less for all duration periods among persons aged 35 years and over than among persons under that age.

Selected indexes by age group and sex.—Table 4 gives certain indexes specific for age group and sex. For example, the annual number of cases per 1,000 males is shown to be 68.3 under 25 years of age and

211.5 at 65 years and over. Among males 35 years and over the rate rises with each succeeding age group. For females the small number of person-years of membership for the older age groups is apparently responsible for the irregularity in the trend of the rates.

TABLE 3.—*Frequency of sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer, by sex for the age groups under 35 years and 35 years and over, by known duration in calendar days, white employees in the soap industry, 1930-34, inclusive*

| Duration of case in calendar days | Males | | Females | |
|--|----------------|-------------------|----------------|-------------------|
| | Under 35 years | 35 years and over | Under 35 years | 35 years and over |
| Annual number of cases per 1,000 persons | | | | |
| All known durations..... | 65.6 | 80.9 | 95.0 | 97.0 |
| 8-14..... | 20.1 | 18.6 | 29.7 | 24.0 |
| 15-28..... | 22.6 | 28.3 | 29.2 | 30.8 |
| 29-49..... | 11.2 | 14.0 | 16.6 | 17.1 |
| 50-91..... | 7.6 | 11.6 | 11.2 | 13.7 |
| 92 and over..... | 4.1 | 8.4 | 8.3 | 11.4 |
| Number of cases of known duration ¹ | | | | |
| All known durations..... | 970 | 1,065 | 332 | 85 |
| 8-14..... | 298 | 245 | 104 | 21 |
| 15-28..... | 334 | 372 | 102 | 27 |
| 29-49..... | 165 | 184 | 58 | 15 |
| 50-91..... | 112 | 153 | 39 | 12 |
| 92 and over..... | 61 | 111 | 29 | 10 |
| Number of person-years of membership..... | 14,792.7 | 13,169.8 | 3,495.8 | 876.7 |

¹ Cases with onset during 1930-34, inclusive.

The annual number of days of disability per person under 25 years of age was 2.0 for males and 2.7 for females. It will be observed that the average number of days of disability increased more rapidly and at an earlier age for females than for males.

The average daily percentage of employees disabled was less than one until the age group 55-64 years was reached for males, while for females the percentage was over one in the age groups 25-34 years and 35-44 years.

Among the males, each case lasted, on the average, 35.5 days, and among the females 34.8 days. In the two age groups, under 25 years and 35-44 years, there was little difference between the sexes with respect to duration of case, but in the age group 25-34 years the cases among females averaged 5.8 days longer.

There were 84 deaths among males and 5 deaths among females, resulting in a mortality rate per 1,000 of 3.0 and 1.1, and a case fatality rate of 3.8 and 1.1 percent, respectively. Both rates for males showed a decided increase with age.

TABLE 4.—Summary of selected morbidity and mortality indexes for different age groups, white male and female employees in the soap industry, 1930-34, inclusive

| Sex | All ages ¹ | Age in years as of July 1, 1932 | | | | | | |
|-------------|-----------------------|---|----------|---------|---------|---------|-------------|--|
| | | Under 25 | 25-34 | 35-44 | 45-54 | 55-64 | 65 and over | |
| | | Annual number of cases per 1,000 persons | | | | | | |
| Male..... | 76.0 | 68.3 | 66.0 | 75.6 | 92.3 | 114.1 | 211.5 | |
| Female..... | 98.1 | 90.9 | 103.7 | 116.0 | 69.4 | 83.6 | ----- | |
| | | Annual number of days of disability per person | | | | | | |
| Male..... | 2.70 | 2.01 | 2.12 | 2.70 | 3.44 | 5.81 | 9.95 | |
| Female..... | 3.41 | 2.71 | 3.93 | 4.28 | 3.10 | 2.98 | ----- | |
| | | Average daily percentage of employees disabled | | | | | | |
| Male..... | 0.7 | 0.6 | 0.6 | 0.7 | 0.9 | 1.6 | 2.7 | |
| Female..... | .9 | .7 | 1.1 | 1.2 | .9 | .8 | ----- | |
| | | Average number of days per case | | | | | | |
| Male..... | 35.5 | 29.5 | 32.1 | 35.7 | 37.3 | 50.9 | 47.0 | |
| Female..... | 34.8 | 29.8 | 37.9 | 36.9 | 44.6 | 35.6 | ----- | |
| | | Annual number of deaths per 1,000 persons | | | | | | |
| Male..... | 3.0 | 1.8 | 1.8 | 3.2 | 3.5 | 9.2 | 24.6 | |
| Female..... | 1.1 | 1.6 | 1.2 | ----- | ----- | ----- | ----- | |
| | | Percent of cases ending fatally | | | | | | |
| Male..... | 3.8 | 2.5 | 2.7 | 4.2 | 3.8 | 7.4 | 10.9 | |
| Female..... | 1.1 | 1.8 | 1.1 | ----- | ----- | ----- | ----- | |
| | | Number of cases beginning during 1930-34, inclusive | | | | | | |
| Male..... | 2,129 | 233 | 751 | 588 | 338 | 174 | 43 | |
| Female..... | 429 | 167 | 172 | 68 | 16 | 5 | ----- | |
| | | Number of calendar days of disability | | | | | | |
| Male..... | 75,490 | 6,874 | 24,096 | 21,010 | 12,603 | 8,856 | 2,023 | |
| Female..... | 14,935 | 4,978 | 6,521 | 2,510 | 714 | 178 | ----- | |
| | | Number of years of disability | | | | | | |
| Male..... | 206.8 | 18.8 | 66.0 | 57.6 | 34.5 | 24.3 | 5.5 | |
| Female..... | 40.9 | 13.6 | 17.9 | 6.9 | 2.0 | .5 | ----- | |
| | | Number of person-years of membership | | | | | | |
| Male..... | 28,001.2 | 3,413.0 | 11,379.7 | 7,778.7 | 3,662.6 | 1,525.2 | 203.3 | |
| Female..... | 4,374.9 | 1,837.5 | 1,658.3 | 586.0 | 230.4 | 59.8 | .5 | |
| | | Number of deaths | | | | | | |
| Male..... | 84 | 6 | 21 | 25 | 13 | 14 | 5 | |
| Female..... | 5 | 3 | 2 | ----- | ----- | ----- | ----- | |
| | | Number of ended cases during 1930-34, inclusive | | | | | | |
| Male..... | 2,184 | 239 | 770 | 600 | 339 | 188 | 46 | |
| Female..... | 439 | 170 | 179 | 67 | 17 | 5 | ----- | |

¹ Includes some of unknown age.

Frequency of disabilities by detailed diagnosis groups.—The annual number of cases per 1,000 persons is shown for each sex, by age group and diagnosis, in table 5. Considering only cases among males, it will be noted that there was a marked increase in frequency with age for certain specific diagnosis groups. This becomes more clear if rates are calculated for the six broad age groups rather than for the two groups as given in the table. Thus, rheumatic diseases, beginning with a rate of 1.5 for males under 25 years, rose in successive 10-year age periods as follows: 2.4, 8.1, 11.7, 17.0, and 44.3, the rate from the youngest to the oldest age group increasing more than 29 times. Diseases of the skin for the same period increased more than 16 times in frequency, while circulatory diseases increased 12 times. Respiratory diseases and digestive diseases did not fluctuate greatly until the oldest age group was reached. Infectious and parasitic diseases showed a greater frequency in the younger age groups; from a rate of 7.6 under 25 years, there was a continuous decline to 2.6 at 55-64 years. Diseases of the pharynx and tonsils and appendicitis likewise were less common in the older age groups.

For females it was not practicable to make a division into age groups other than under 35 years and 35 years and over. According to this division, a pronounced rise in rate with age is observed for nonindustrial injuries, diseases of the circulatory system, and diseases of the skin. A sharp decrease among older persons was noted for respiratory diseases, especially diseases of the pharynx and tonsils, and influenza and grippe. The same was also shown for appendicitis, and for infectious and parasitic diseases. In general the most decided changes with age among females followed the same trend as among males. Notable exceptions are the decline in the respiratory disease rate for older females and the failure of the rheumatic rate to show a rapid increase with age.

While for all disabilities the female rate for ages under 35 years was 46 percent in excess of the corresponding male rate, and 17 percent in excess for ages 35 years and over, yet there were specific diagnosis groups where the opposite trend was observed. For pneumonia and hernia the rate for males was higher among both young and old persons. Indeed, no cases of hernia were reported among females. For males under 35 years the rate was greatly in excess for nonindustrial injuries and to a lesser extent for diseases of the teeth and gums, ulcer of the stomach or duodenum, and diseases of the circulatory system. Among males 35 years of age and older there was an excess in the rate for diseases of the pharynx and tonsils, acute and chronic bronchitis, respiratory tuberculosis, influenza and grippe, rheumatic diseases, and infectious and parasitic diseases. The excess in the rate for females was most pronounced for influenza and grippe and genitourinary diseases among the younger

TABLE 5.—*Frequency of sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer, by sex, for the age groups under 55 years and 55 years and over, according to detailed diagnosis groups, white employees in the soap industry, 1930-34, inclusive*

| Diagnosis | Annual number of cases per 1,000 persons | | | | | | Number of cases ¹ | | | | | |
|--|--|----------------|-------------------|---------------|----------------|-------------------|------------------------------|----------------|-------------------|-----------------------|----------------|-------------------|
| | White males | | | White females | | | White males | | | White females | | |
| | All ages | Under 35 years | 35 years and over | All ages | Under 35 years | 35 years and over | All ages ² | Under 35 years | 35 years and over | All ages ³ | Under 35 years | 35 years and over |
| Total, all diagnoses | 76.0 | 66.5 | 86.8 | 98.1 | 97.0 | 101.5 | 2,129 | 984 | 1,143 | 429 | 339 | 89 |
| Nonindustrial injuries | 8.0 | 7.2 | 9.0 | 4.8 | 2.9 | 12.5 | 225 | 106 | 119 | 21 | 10 | 11 |
| Sickness | 68.0 | 59.3 | 77.8 | 93.3 | 94.1 | 89.0 | 1,904 | 878 | 1,024 | 408 | 329 | 78 |
| Respiratory diseases | 27.8 | 26.8 | 28.9 | 40.3 | 43.2 | 27.4 | 779 | 397 | 381 | 176 | 151 | 24 |
| Diseases of the pharynx and tonsils | 5.7 | 7.6 | 3.5 | 9.6 | 11.8 | 1.1 | 159 | 113 | 46 | 42 | 41 | 1 |
| Bronchitis, acute and chronic | 2.2 | 1.5 | 3.1 | 2.7 | 2.9 | 2.3 | 63 | 22 | 41 | 12 | 10 | 2 |
| Other diseases of the upper respiratory tract | 1.8 | 1.8 | 2.0 | 3.2 | 2.6 | 4.6 | 82 | 26 | 26 | 14 | 9 | 4 |
| Influenza, gripe | 14.2 | 12.5 | 16.1 | 20.8 | 22.0 | 16.0 | 397 | 185 | 212 | 91 | 77 | 14 |
| Pneumonia, all forms | 1.7 | 1.3 | 2.0 | 1.2 | 1.1 | 1.1 | 47 | 20 | 27 | 5 | 4 | 1 |
| Pleurisy | 1.9 | 1.0 | 1.7 | 1.4 | 1.1 | 2.3 | 25 | 15 | 10 | 6 | 4 | 2 |
| Respiratory tuberculosis | 1.0 | 1.0 | 1.1 | 1.2 | 1.4 | 1.4 | 28 | 13 | 14 | 5 | 5 | 5 |
| Other respiratory diseases | .3 | .2 | .4 | .2 | .3 | .3 | 8 | 3 | 5 | 1 | 1 | 1 |
| Digestive diseases | 13.4 | 12.9 | 12.9 | 20.8 | 20.0 | 24.0 | 375 | 205 | 170 | 91 | 70 | 21 |
| Diseases of the teeth and gums | .9 | 1.1 | .6 | .9 | .8 | 1.2 | 24 | 16 | 8 | 4 | 3 | 1 |
| Ulcer of the stomach or duodenum | 1.4 | .8 | 2.0 | .9 | .6 | 2.3 | 38 | 12 | 26 | 4 | 2 | 2 |
| Other diseases of the stomach, cancer excepted | .9 | .6 | 1.3 | 1.4 | 1.4 | 1.2 | 26 | 8 | 18 | 6 | 5 | 1 |
| Diarrhea, enteritis | 1.7 | 1.3 | 2.3 | 3.0 | 2.9 | 3.4 | 40 | 19 | 30 | 13 | 10 | 8 |
| Appendicitis, with or without appendectomy | 5.3 | 7.4 | 2.9 | 11.6 | 12.3 | 9.1 | 148 | 110 | 38 | 51 | 43 | 8 |
| Hernia | 1.3 | 1.3 | 1.3 | 3.0 | 2.0 | 6.8 | 36 | 19 | 17 | 13 | 7 | 6 |
| Other digestive diseases | 1.9 | 1.4 | 2.5 | .2 | .2 | .2 | 54 | 21 | 33 | 13 | 7 | 6 |
| Nonrespiratory-nondigestive diseases | 26.4 | 18.5 | 35.2 | 32.0 | 30.6 | 37.6 | 738 | 274 | 463 | 140 | 107 | 33 |
| Diseases of the circulatory system | 3.8 | 1.9 | 6.0 | 2.3 | 1.1 | 6.8 | 107 | 28 | 79 | 25 | 4 | 6 |
| Genitourinary diseases | 2.9 | 2.2 | 3.6 | 5.7 | 5.7 | 5.7 | 87 | 33 | 47 | 10 | 20 | 5 |
| Rheumatic diseases | 6.2 | 2.9 | 10.7 | 3.2 | 3.1 | 3.4 | 173 | 32 | 141 | 11 | 33 | 3 |
| Diseases of the nervous system | 1.9 | 1.9 | 1.8 | 4.6 | 4.3 | 5.7 | 58 | 29 | 29 | 20 | 15 | 5 |
| Diseases of the skin | 1.7 | .9 | 2.6 | 1.6 | .9 | 4.6 | 47 | 13 | 34 | 7 | 3 | 4 |
| Other infectious and parasitic diseases | 5.5 | 6.2 | 4.6 | 7.2 | 3.4 | 3.4 | 154 | 92 | 61 | 28 | 25 | 3 |
| Other nonrespiratory-nondigestive diseases | 4.4 | 3.2 | 5.9 | 8.2 | 8.3 | 8.0 | 124 | 47 | 77 | 36 | 29 | 7 |
| Ill-defined or unknown diagnoses | .4 | .1 | .8 | .2 | .3 | .3 | 12 | 2 | 10 | 1 | 1 | 1 |
| Number of person-years of membership | 28,001.2 | | | | | | 14,762.7 | | | | | |
| | 3,493.8 | | | | | | 3,493.8 | | | | | |

¹ See table 3, footnote 1.

² Includes 2 cases of unknown age.

³ Includes 1 case of unknown age.

NOTE.—Of interest is the information available for the same period from a rubber manufacturing company which shows the following rates for white males of all ages: All diagnoses, 78.0; nonindustrial injuries, 14.3; respiratory diseases, 20.4 (the difference reflecting principally cases of influenza and gripe); digestive diseases, 14.4; nonrespiratory-nondigestive diseases, 27.8; and unknown diagnoses, 0.9. Specific diseases which had slightly higher rates than for the soap industry included diseases of the circulatory system, 4.5; rheumatic diseases, 7.4, and diseases of the skin, 2.5.

group, and appendicitis and diseases of the nervous system among those of all ages.

From the viewpoint of the four principal diagnosis groups, for all ages the position of females was most unfavorable for digestive diseases, with an excess in the rate of 55 percent, while for respiratory diseases there was an excess of 45 percent, and for nonrespiratory-nondigestive diseases an excess of 21 percent. Nonindustrial injuries were less common among females. The fact that maternity cases were not eligible for sickness benefits should be kept in mind when comparing rates for the sexes

Rates by occupation.—The frequency of disabilities for each sex, by occupation, is shown, among other things, in table 6 and the age-standardized frequency rates are shown graphically in decreasing order of magnitude in figure 1. It will be observed that the rates for males vary from 134.9 cases per 1,000 for soap handlers and process laborers to 31.8 for office workers. The rates for females, on the other hand, describe a narrower range, varying from 117.1 for packing-machine operators to 74.5 for office workers. Each of the 3 male occupations having standardized rates greater than 100 includes laborers, while occupations with the lowest rates include supervisory and white-collar workers. Packing-machine operators and process operators have rates nearest to that for all occupations (86.1).

TABLE 6.—Frequency of sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer, annual number of days of disability per person, and average number of days per case, by occupational group and sex, white employees in the soap industry, 1930-34, inclusive

| Occupationalgroup | Annual number of cases per 1,000 persons | | Annual number of days of disability per person | Average number of days per case | Number of cases ² | Number of calendar days of disability | Number of person-years of membership |
|---|--|---------------------------|--|---------------------------------|------------------------------|---------------------------------------|--------------------------------------|
| | Crude | Standardized ¹ | | | | | |
| | Males | | | | | | |
| Soap handlers and process laborers..... | 116.5 | 134.9 | 4.11 | 35.3 | 259 | 9,141 | 2,223.4 |
| Laborers (n. e. c.)..... | 117.3 | 126.7 | 4.35 | 37.1 | 133 | 4,937 | 1,133.7 |
| Warehouse laborers..... | 101.3 | 110.7 | 2.97 | 29.3 | 109 | 3,193 | 1,076.0 |
| Maintenance workers..... | 99.4 | 98.1 | 3.44 | 34.6 | 427 | 14,762 | 4,293.7 |
| Packing laborers..... | 93.0 | 93.5 | 3.46 | 37.2 | 178 | 6,618 | 1,914.7 |
| Packing-machine operators..... | 98.4 | 86.1 | 3.31 | 33.7 | 80 | 2,695 | 813.2 |
| All occupations..... | 76.0 | 86.1 | 2.70 | 35.5 | 2,129 | 75,490 | 28,001.2 |
| Process operators..... | 72.0 | 78.9 | 2.56 | 35.5 | 229 | 8,134 | 3,180.5 |
| Salesmen..... | 59.7 | 64.1 | 2.12 | 35.6 | 253 | 9,002 | 4,239.3 |
| Foremen..... | 48.3 | 59.3 | 2.01 | 41.6 | 103 | 4,288 | 2,132.2 |
| Office workers..... | 33.2 | 31.8 | 1.01 | 30.3 | 131 | 3,975 | 3,947.8 |
| All others..... | 74.5 | 78.2 | 2.87 | 38.5 | 227 | 8,745 | 3,046.7 |
| | Females | | | | | | |
| Packing-machine operators..... | 138.2 | 117.1 | 5.26 | 38.1 | 182 | 6,933 | 1,316.9 |
| All occupations..... | 98.1 | 98.1 | 3.41 | 34.8 | 429 | 14,955 | 4,374.9 |
| Office workers..... | 75.3 | 74.5 | 2.35 | 31.2 | 191 | 5,955 | 2,536.9 |
| All others..... | 107.5 | 93.4 | 3.93 | 36.6 | 56 | 2,047 | 821.1 |

¹ Age standardized according to the total white gainfully employed workers in the United States (6).

² See table 3, footnote 1.

The annual number of days of disability per worker for males, as shown in table 6, will be observed to follow almost the same ranking by occupation as the standardized frequency rates, the highest being 4.35 days for laborers (not elsewhere classified) and the lowest being 1.01 days for office workers. On the other hand, the average number of days per case does not rank by occupation in the same order as the two rates just mentioned. Foremen, with comparatively infrequent disabilities, had the maximum average number of days per case of 41.6, while the minimum average number of days per case was 29.3 for warehouse laborers who had a high frequency rate.

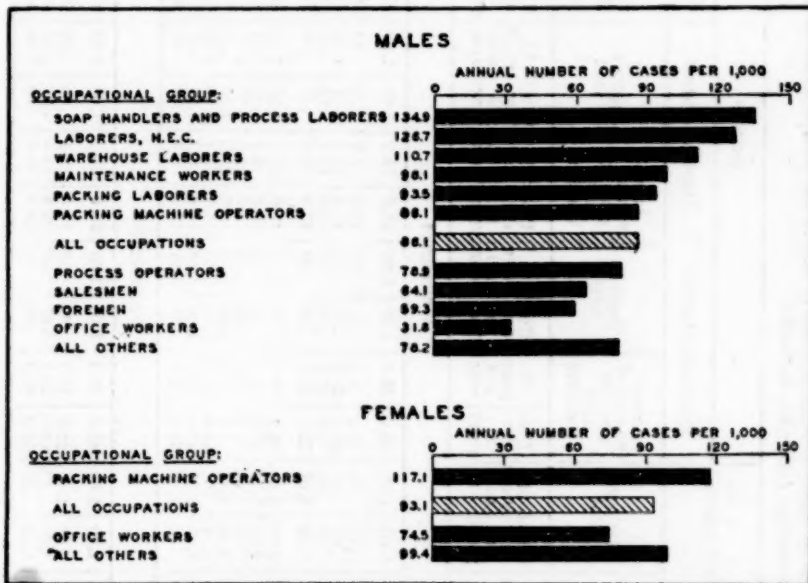


FIGURE 1.—Annual number of cases per 1,000 males and females, respectively, of sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer according to occupational group, white employees in the soap industry, 1930-34, inclusive. (The rates are age-standardized according to the total white gainfully employed workers in the United States.)

Frequency of disabilities by occupation, age, and broad diagnosis groups.—Table 7 shows for a twofold age division of each occupational group the frequency of disabilities by broad diagnosis groups. It is of interest to know the type of diagnosis which is relatively the most unfavorable for a particular occupation. A certain rate may be low with respect to all occupations, yet high from the viewpoint of the occupation itself. For males under 35 years of age the highest ratios of specific rate to the rate for all occupations were as follows: Nonindustrial injuries among soap handlers and process laborers, warehouse laborers, packing-machine operators, and process operators; respiratory diseases among laborers (not elsewhere classified) and maintenance workers; digestive diseases among salesmen, foremen,

TABLE 7.—Frequency of sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer for each occupational group by age, under 35 years and 35 years and over, and ratio of specific occupational group to all occupations, according to broad diagnosis groups, white male and white female employees in the soap industry, 1930-34, inclusive

| Occupational group | All sickness and nonindustrial injuries ¹ | | | | Nonindustrial injuries | | | | Sickness | | | | Person-years of membership | | | |
|---|--|-------------------|-------------------|-------------------|--|-------------------|-------------------|-------------------|----------------------|-------------------|--------------------|-------------------|--------------------------------------|-------------------|-------------------|-------------------|
| | Annual number of cases per 1,000 members | | Ratio to total | | Annual number of cases per 1,000 members | | Ratio to total | | Respiratory diseases | | Digestive diseases | | Nonrespiratory-nondigestive diseases | | Ratio to total | |
| | Under 35 years | | 35 years and over | | Under 35 years | | 35 years and over | | Under 35 years | | Under 35 years | | Under 35 years | | Under 35 years | |
| | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over | 35 years and over |
| White males | | | | | | | | | | | | | | | | |
| All occupations..... | 66.5 | 86.8 | 1.00 | 1.00 | 7.2 | 9.0 | 1.00 | 1.00 | 26.8 | 28.9 | 1.00 | 1.00 | 13.9 | 12.9 | 1.00 | 1.00 |
| Office workers..... | 37.4 | 23.6 | .56 | .27 | 2.9 | 3.4 | .40 | .38 | 14.5 | 8.4 | .54 | .29 | 10.2 | 6.7 | .73 | .53 |
| Salesmen..... | 57.2 | 62.6 | .86 | .72 | 4.3 | 3.6 | .60 | .40 | 20.7 | 20.9 | .77 | .72 | 17.6 | 14.6 | .81 | .65 |
| Foremen..... | 30.5 | 61.2 | .46 | .71 | 4.5 | 6.4 | .62 | .71 | 7.9 | 13.7 | .29 | .47 | 9.1 | 11.3 | .65 | .88 |
| Process operators..... | 67.9 | 76.3 | 1.02 | .88 | 8.9 | 15.0 | 1.24 | 1.67 | 25.4 | 23.1 | .95 | .80 | 10.8 | 6.9 | .78 | .53 |
| Soap handlers and process laborers..... | 114.1 | 119.2 | 1.72 | 1.37 | 14.5 | 13.4 | 2.01 | 1.49 | 51.1 | 33.4 | 1.91 | 1.16 | 17.0 | 25.7 | 1.22 | 1.99 |
| Packing-machine operators..... | 95.5 | 106.7 | 1.44 | 1.23 | 14.8 | 19.4 | 2.06 | 2.16 | 37.9 | 63.1 | 1.41 | 2.18 | 16.5 | 9.7 | 1.19 | 1.75 |
| Warehouse laborers..... | 77.9 | 116.9 | 1.17 | 1.35 | 6.0 | 9.4 | .83 | 1.04 | 33.4 | 40.3 | 1.25 | 1.39 | 12.0 | 17.5 | .86 | 1.36 |
| Maintenance workers..... | 105.8 | 97.7 | 1.59 | 1.13 | 24.9 | 11.8 | 3.46 | 1.31 | 35.2 | 38.7 | 1.31 | 1.34 | 18.7 | 11.8 | 1.35 | .91 |
| Laborers (n. e. c.)..... | 82.1 | 110.9 | 1.23 | 1.28 | 8.0 | 8.6 | 1.11 | .96 | 40.5 | 40.5 | 1.31 | 1.40 | 16.7 | 15.7 | 1.20 | 1.22 |
| All others..... | 101.3 | 129.3 | 1.52 | 1.49 | 10.3 | 12.3 | 1.43 | 1.37 | 47.6 | 47.7 | 1.78 | 1.65 | 18.6 | 9.2 | 1.34 | .71 |
| | 55.1 | 96.3 | .83 | 1.11 | 3.8 | 9.7 | .53 | 1.08 | 24.4 | 29.1 | .91 | 1.01 | 12.5 | 9.7 | .90 | .75 |
| | | | | | | | | | | | | | | | | |
| White females | | | | | | | | | | | | | | | | |
| All occupations..... | 97.0 | 101.5 | 1.00 | 1.00 | 2.9 | 12.5 | 1.00 | 1.00 | 43.2 | 27.4 | 1.00 | 1.00 | 20.0 | 24.0 | 1.00 | 1.00 |
| Office workers..... | 71.1 | 92.9 | .73 | .92 | 1.9 | 17.7 | .66 | 1.42 | 29.8 | 17.7 | .69 | .65 | 17.8 | 15.5 | .89 | .65 |
| Packing-machine operators..... | 142.7 | 104.4 | 1.47 | 1.03 | 4.3 | 6.5 | 1.48 | .52 | 67.9 | 26.1 | 1.57 | .95 | 25.8 | 19.6 | 1.29 | .82 |
| All others..... | 100.1 | 114.3 | 1.03 | 1.13 | 4.0 | 7.4 | 1.38 | .59 | 40.0 | 44.2 | .93 | 1.01 | 12.0 | 40.6 | .60 | 1.69 |
| | | | | | | | | | | | | | | | | |

¹ Includes a small number of cases with ill-defined or unknown diagnosis.

and office workers; and nonrespiratory-nondigestive diseases among packing laborers. On the other hand, for males 35 years of age and over the highest ratios were for nonindustrial injuries among process operators; respiratory diseases among warehouse laborers, maintenance workers, and packing-machine operators; digestive diseases among soap handlers and process laborers, salesmen, foremen, and office workers; and nonrespiratory-nondigestive diseases among laborers (not elsewhere classified) and packing laborers. It will be observed that digestive diseases are in the most unfavorable position among persons of all ages who have low total frequency rates and are engaged in nonmanual occupations. Those who are engaged in strenuous manual labor and have high total rates are inclined to show an excess of nonindustrial injuries when young and of respiratory diseases when older.

The highest sickness rates among persons under 35 years were for respiratory diseases in 10 out of 11 occupational groups. In 8 occupational groups the second highest rates were for nonrespiratory-nondigestive diseases, and the third highest rates for digestive diseases. Among persons 35 years and over respiratory diseases held first place in 5 occupational groups and nonrespiratory-nondigestive diseases took first place in 6 occupational groups. Digestive diseases fell to third place in all but one group. The increasing absolute importance of nonrespiratory-nondigestive diseases among older people is clearly shown by these figures.

Included under the classification of nonrespiratory-nondigestive diseases there were some specific diseases which had much higher rates in certain occupations, as is shown in the following table giving the rate per 1,000 males. In each instance it will be noted that the frequency of a particular disease in certain occupations far exceeds the rate for the same disease in all occupations. Age apparently does not greatly influence the excess, which remains relatively the same among both the older and younger groups.

| Diagnosis group | Occupational group | Annual number of cases per 1,000 males | |
|---------------------------|---|--|-------------------|
| | | Under 35 years | 35 years and over |
| Circulatory diseases..... | Soap handlers and process laborers..... | 3.4 | 13.3 |
| | All occupations..... | 1.9 | 6.0 |
| Rheumatic diseases..... | Packing laborers..... | 5.1 | 22.8 |
| | Laborers (n. e. c.)..... | 6.2 | 26.2 |
| | All occupations..... | 2.2 | 10.7 |
| Skin diseases..... | Maintenance workers..... | 2.3 | 5.5 |
| | All occupations..... | .9 | 2.6 |

Rates by socio-economic class.—Table 8 and figure 2, which show the frequency of sickness and nonindustrial injuries by socio-economic class, reflect the influence of standards of living and of home condi-

tions more than a strictly occupational classification. Since the non-working environment is of great importance with respect to the occurrence of disabilities, a classification which takes this into account will show definite gradations. Among males the different socio-economic classes arrange themselves as follows, when the corresponding frequency rates are written in order of increasing magnitude: clerks and salesmen, skilled workers and foremen, semiskilled workers, and un-

TABLE 8.—*Frequency of sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer by socio-economic class and sex according to broad diagnosis groups, annual number of days of disability per person, and average number of days per case by socio-economic class and sex, white employees in the soap industry, 1930-34, inclusive*

| Diagnosis group | Males | | | | | | Females | | | |
|--|----------|---------------------|-----------------------------|---------------------------------------|-------------------|------------|---------|---------|---------------------------------------|------------|
| | Total | Clerks and salesmen | Skilled workers and foremen | Semi-skilled workers in manufacturing | Unskilled workers | All others | Total | Clerks | Semi-skilled workers in manufacturing | All others |
| Annual number of cases per 1,000 persons | | | | | | | | | | |
| Total, all diagnoses ¹ | 76.0 | 50.5 | 72.5 | 89.4 | 102.5 | 59.8 | 98.1 | 74.6 | 136.6 | 109.1 |
| Nonindustrial injuries.... | 8.0 | 4.0 | 6.1 | 11.3 | 12.9 | 4.7 | 4.8 | 4.4 | 4.4 | 7.8 |
| Sickness ¹ | 68.0 | 46.5 | 66.4 | 78.1 | 89.6 | 55.1 | 93.3 | 70.2 | 132.2 | 101.3 |
| Respiratory diseases.... | 27.8 | 17.9 | 24.9 | 33.9 | 39.1 | 20.9 | 40.3 | 28.1 | 60.6 | 44.8 |
| Digestive diseases.... | 13.4 | 13.6 | 12.5 | 13.2 | 15.4 | 10.1 | 20.8 | 16.8 | 26.3 | 25.3 |
| Nonrespiratory-non-digestive diseases.... | 26.4 | 14.9 | 28.5 | 30.6 | 34.4 | 23.7 | 32.0 | 24.9 | 45.3 | 31.2 |
| Annual number of days of disability per person | | | | | | | | | | |
| Total, all diagnoses..... | 2.70 | 1.69 | 2.69 | 2.69 | 3.66 | 2.36 | 3.41 | 2.31 | 5.27 | 3.81 |
| Average number of days per case | | | | | | | | | | |
| Total, all diagnoses..... | 35.5 | 33.5 | 37.2 | 33.4 | 35.7 | 39.5 | 34.8 | 31.0 | 38.6 | 34.9 |
| Number of cases ² | | | | | | | | | | |
| Total, all diagnoses ¹ | 2,129 | 367 | 460 | 427 | 721 | 154 | 429 | 186 | 187 | 56 |
| Nonindustrial injuries.... | 225 | 29 | 39 | 54 | 91 | 12 | 21 | 11 | 6 | 4 |
| Sickness ¹ | 1,904 | 338 | 421 | 373 | 630 | 142 | 408 | 175 | 181 | 52 |
| Respiratory diseases.... | 779 | 130 | 158 | 162 | 275 | 54 | 176 | 70 | 83 | 23 |
| Digestive diseases.... | 375 | 99 | 79 | 63 | 108 | 26 | 91 | 42 | 36 | 13 |
| Nonrespiratory-non-digestive diseases.... | 738 | 108 | 181 | 146 | 242 | 61 | 140 | 62 | 62 | 16 |
| Number of calendar days of disability | | | | | | | | | | |
| Total, all diagnoses..... | 75,490 | 12,307 | 17,087 | 14,272 | 25,744 | 6,080 | 14,935 | 5,762 | 7,219 | 1,954 |
| Number of person-years of membership | | | | | | | | | | |
| Total, all diagnoses..... | 28,001.2 | 7,272.8 | 6,343.7 | 4,773.8 | 7,035.6 | 2,575.3 | 4,374.9 | 2,492.5 | 1,369.2 | 513.2 |

¹ Includes some cases of ill-defined or unknown diagnosis.

² See table 3, footnote 1.

skilled workers. From the first to the last class the rate more than doubled. A similar trend is apparent for each diagnosis group. There was relatively least difference for digestive diseases between the most favored and the least favored socio-economic class and most difference for nonindustrial injuries. The excess in the rate for skilled workers over white-collar workers was almost the same as the excess in the rate for unskilled over skilled. For semiskilled workers the rates were more nearly like those for the unskilled than the skilled.

The females fell chiefly into two socio-economic classes, clerks and semiskilled workers. The latter had a rate 83 percent in excess of the

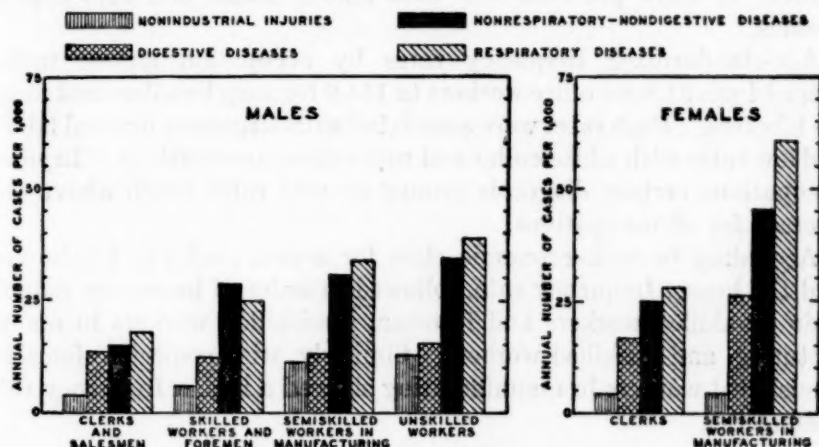


FIGURE 2.—Annual number of cases per 1,000 males and females, respectively, of sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer by socio-economic class, according to broad diagnosis group, white employees in the soap industry, 1930-34, inclusive.

former for all diagnosis groups, although the rates for nonindustrial injuries were the same; the excess for respiratory diseases was 116 percent, and for nonrespiratory-nondigestive diseases 82 percent.

According to table 8 the annual number of days of disability per worker for males varied from 1.69 for clerks and salesmen to 3.66 for unskilled workers. The rate for females, which was 26 percent greater than that for males for all classes, was 76 percent greater for semiskilled workers.

For males the average number of days per case does not follow so regular a trend. Unskilled workers had disabilities lasting longer than did clerical or semiskilled workers, but for skilled workers and foremen the average length of case was greater than for the other three groups. Probably this rate was influenced by the fact that the group of skilled workers and foremen included a large proportion of older persons, whose disabilities tend to last longer than those of younger persons.

For female clerks the duration of cases was shorter than for male clerks and salesmen. The reverse was observed for semiskilled workers in manufacturing, where the cases among females were longer by an average of 5.2 days.

SUMMARY

This report deals with sickness and nonindustrial injuries causing disability lasting 8 calendar days or longer among persons engaged in the soap industry. The annual number of cases per 1,000 was 76.0 for males and 98.1 for females, while the annual number of days of disability per person was 2.70 and 3.41, respectively. The average number of days per case was 35.5 among males and 34.8 among females.

Age-standardized frequency rates by occupation among males ranged from 31.8 for office workers to 134.9 for soap handlers and process laborers. High rates were associated with strenuous manual labor, and low rates with white-collar and supervisory occupations. In some occupations certain diagnosis groups showed rates much above the average for all occupations.

According to socio-economic class for males, clerks and salesmen had the lowest frequency rate, followed in order of increasing magnitude by skilled workers and foremen, semiskilled workers in manufacturing, and unskilled workers. Similarly, with respect to females, semiskilled workers in manufacturing showed a higher frequency rate than clerks.

REFERENCES

- (1) Sayers, R. R., DallaValle, J. M., and Bloomfield, S. G.: Occupational and environmental analysis of the cement, clay, and pottery industries. Pub. Health Bull. No. 238. Washington, Government Printing Office (1937).
- (2) Sayers, R. R., Kroeger, G., and Gafafer, W. M.: General aspects and functions of the sick benefit organization. Pub. Health Rep., **52**: 1563-1580 (1937). (Reprint No. 1874.)
- (3) Gafafer, W. M.: Frequency of sickness and nonindustrial accidents causing disability lasting eight calendar days or longer among 60,000 white male railroad employees, 1930-34, inclusive. Pub. Health Rep., **53**: 555-573 (1938). (Reprint No. 1924.)
- (4) Brinton, H. P.: Disabling sickness and nonindustrial injuries among drivers and other employees of certain bus and cab companies, 1930-34, inclusive. Pub. Health Rep., **54**: 459-468 (1939). (Reprint No. 2049.)
- (5) Seifert, H. E.: The coding of occupations for machine tabulating purposes with reference principally to studies on occupational morbidity. J. Ind. Hyg. (In press.)
- (6) U. S. Department of Commerce, Bureau of the Census: Fifteenth Census of the United States, 1930. Population, vol. 5, General Report on Occupations. Washington, Government Printing Office (1933). P. 117, pp. 436-437.
- (7) Thomssen, E. G., and Kemp, C. R.: Modern Soap Making. MacNair-Dorland Company, New York (1937).

STUDIES IN CHEMOTHERAPY

IX. ANTIBACTERIAL ACTION OF SOME AROMATIC ARSENIC, SULFUR, AND NITRO COMPOUNDS

By SANFORD M. ROSENTHAL, *Senior Pharmacologist*, HUGO BAUER, *Research Associate, Division of Pharmacology*, and ELIAS ELVOVE, *Senior Chemist, Division of Chemistry, National Institute of Health, United States Public Health Service*

Since the original discovery of Prontosil by Domagk many compounds have been investigated for chemotherapeutic activity. Studies have been directed both to obtaining more effective derivatives and to investigating the relation of chemical structure to therapeutic action. Tréfouël, Nitti, and Bovet first demonstrated the anti-streptococcal action of sulfanilamide (p-aminobenzene sulfonamide) and later reported upon a large series of compounds related to it (1, 2). Other contributions include those of Buttle, Gray, and Stephenson (3, 14, 15), Fourneau et al. (4, 5), Goissedet et al. (6), Gley (7), Girard (8), Bauer and Rosenthal (9), Mayer and Oechslin (10), Mietzsch (11), Whitby (12), Crossley, Northey, and Hultquist (13). Significant knowledge concerning the effects of position in the benzene ring and of substitutions or replacements of the amino or sulfonamide radical has been gained from such studies.

The discovery of the antibacterial activity of the diphenyl-sulfones, sulfides, disulfides, and sulfoxides (Buttle (14, 15), Fourneau et al. (16), Gley (7) and Girard (8)) marked the first active compounds that did not contain sulfonamide groups.

Active compounds previously described have practically all been sulfur derivatives. While Levaditi (17) found that hydroquinone and 4,4'-dioxiazobenzene possess some activity, this action was limited to the "toxi-infection" of the meningococcus and gonococcus in mice, and perhaps related to an antiendotoxic effect under these conditions. Kolmer, Brown, and Raiziss (20) have reported upon the activity of 2-amino-5-iodopyridine in suppurative streptococcal lesions in rabbits.

TECHNIQUE

All experiments were carried out upon albino mice. The drugs were administered by mouth or subcutaneously, usually in one-half of the maximum tolerated dose (M. T. D.). The M. T. D. was accepted as the maximum single dose of the drug that killed not more than 10 percent of the animals. Therapy was begun within one-half hour after inoculation of the organisms, and repeated at daily intervals for several doses. Subcutaneous injections of insoluble compounds were made in 0.1 cc. of olive oil. Acid solutions were neutralized with sodium bicarbonate prior to administration.

In the present study the therapeutic index, derived from the ratio of the maximum tolerated dose to the minimum effective dose, as

defined below, is only a rough approximation; it is intended to represent only a qualitative appraisal of activity to be employed for purposes of comparison, and not a final coefficient of curative power.

It has become evident (18, 19) that toxicity varies considerably from one species to another, and also that the acute toxicity is no reliable indication of the amount of drug which will be tolerated on repeated administration. Another source of difficulty is the variation in therapeutic activity that is experienced from one experiment to another and from one strain of organism to another. The minimum effective dose (M. E. D.) is also conditioned by the length of treatment, the route of administration, the period of observation, and the percentage of survivals taken to represent an effective dose. Even when these factors are standardized, considerable variation in results occurs. The activity of compounds in relation to one another is more constant. In studying a large series of compounds it is desirable to have some basis of comparison; the information obtained under the conditions of our experiments is of value for a preliminary comparison. For our present purposes the survival of one-third to two-thirds of the animals for 10 days was taken as a measure of a minimum effective dose. The results of several experiments were considered in the determination of the M. E. D.

Two highly virulent strains of hemolytic streptocci were employed. Eighteen-hour peptone broth cultures containing rabbit blood were diluted in broth 10^{-6} , and 0.5 cc. was inoculated intraperitoneally. This represented 100 to 1,000 lethal doses of the organisms. Similar tests were carried out with two strains of type I pneumococcus.

RESULTS WITH ARSENIC COMPOUNDS

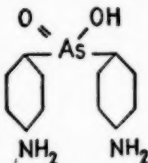

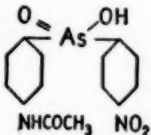
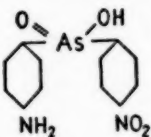
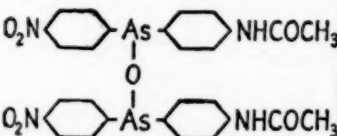
We have investigated a series of compounds structurally similar to some active sulfur compounds, but differing in that the sulfur was replaced by tri- or pentavalent arsenic. Fourneau, Tréfouël, Nitti, and Bovet (4) have replaced the sulfonamide radical of sulfanilamide by NH_2 , CN , SO_3H , AsO_3H_2 and CONH_2 , and in each instance the antistreptococcal action was abolished. Tréfouël, Nitti, and Bovet (2) also prepared a series of arsenic benzene derivatives containing amino or substituted amino groups (including azo compounds), all of which were inactive.

The toxicity for mice of the arsenic compounds used in this study is shown in table 1. The trivalent arsenicals all possessed irritant properties, as shown by local induration at the site of the injection.

No active arsenic compounds structurally analogous to sulfanilamide were obtained. 4-Aminophenyl and 4-nitrophenyl arsonic acid were inactive. Tryparsamide was inactive although it was tolerated in mice in doses up to 1.0 gm. per kilo (tables 4 and 5).

The sulfur compounds most active against streptococci are 4,4'-diaminodiphenylsulfone and the corresponding nitroamino derivative. We have found 4,4'-diaminodiphenylarsinic acid (Ba 25) and the corresponding arsyloxide (Ba 28) devoid of action. However, 4-nitro-4'-aminodiphenylarsinic acid (Ba 30) showed some activity both by mouth and upon subcutaneous injection (tables 2, 3, and 5).

TABLE 1.—Preliminary study of acute toxicity for mice of some arsenic and sulfur compounds

| Compound | Number of mice | Dose (gm. per kilo) | Route | Mortality (percent) |
|---|----------------|---------------------|------------------------------|---------------------|
| Ba 25.  | 8 | 0.05 | S. C. | 0 |
| | 8 | .125 | S. C. | 25 |
| | 8 | .25 | S. C. | 100 |
| | 10 | .15 | Oral..... | 0 |
| | 10 | .3 | Oral..... | 0 |
| | 5 | .05 | I. V. | 0 |
| | 5 | .1 | I. V. | 0 |
| | | | | |
| Ba 28.  | 5 | 0.01 | S. C. (4) ¹ | 0 |
| | 5 | .025 | S. C. (4)..... | 0 |
| | 10 | .05 | S. C. | 70 |
| | 10 | .10 | S. C. | 100 |
| Ba 29.  | 5 | 0.05 | S. C. | 0 |
| | 5 | .1 | S. C. | 0 |
| | 5 | .25 | S. C. | 80 |
| | 5 | .5 | S. C. | 100 |
| | 10 | .25 | Oral..... | 0 |
| | 5 | .5 | Oral..... | 0 |
| | 5 | 1.0 | Oral..... | 40 |
| | | | | |
| Ba 30.  | 5 | 0.025 | S. C. | 20 |
| | 5 | .05 | S. C. | 0 |
| | 5 | .10 | S. C. | 100 |
| | 5 | .25 | Oral (2)..... | 0 |
| | 5 | .5 | Oral (2)..... | 100 |
| | | | | |
| Ba 31.  | 10 | 0.025 | S. C. (oil)..... | 0 |
| | 10 | .05 | S. C. | 0 |
| | 5 | .1 | S. C. | 40 |
| | 5 | .2 | S. C. | 40 |
| | 5 | .025 | Oral..... | 80 |
| | 5 | .05 | Oral..... | 100 |
| | | | | |
| | | | | |

¹ Figures in parentheses represent repetition of dosage on successive days.

TABLE 1.—*Preliminary study of acute toxicity for mice of some arsenic and sulfur compounds—Continued*

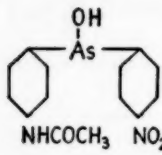
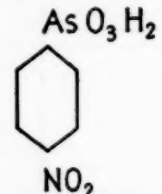
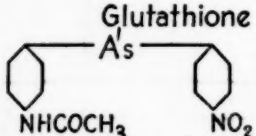
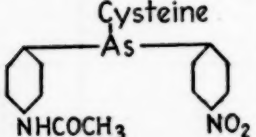
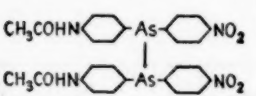
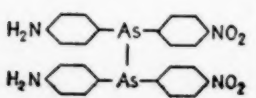
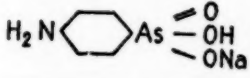
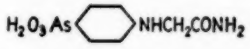
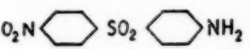
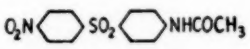
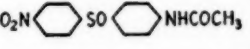
| Compound | Number of mice | Dose (gm. per kilo) | Route | Mortality (percent) |
|---|----------------|---------------------|------------------|---------------------|
| Ba 31b. | 5 | 0.025 | S. C. (oil)..... | 0 |
| | 5 | .05 | S. C. | 0 |
| | 10 | .1 | S. C. | 10 |
| | 5 | .25 | S. C. | 20 |
|  | | | | |
| Ba 33. | 5 | 0.025 | S. C. | 0 |
| | 5 | .05 | S. C. | 0 |
| | 5 | .075 | S. C. | 40 |
| | 5 | .10 | S. C. | 80 |
| | 5 | .25 | S. C. | 100 |
|  | | | | |
| Ba 34. | 5 | 0.0125 | S. C. | 0 |
| | 13 | .025 | S. C. | 77 |
| | 6 | .05 | S. C. | 100 |
|  | | | | |
| Ba 42. | 5 | 0.025 | S. C. | 0 |
| | 5 | .05 | S. C. | 0 |
| | 5 | .10 | S. C. | 80 |
|  | | | | |
| Ba 46. | 5 | 0.10 | S. C. (oil)..... | 0 |
| | 5 | .20 | S. C. | 0 |
| | 6 | .4 | S. C. | 33 |
|  | | | | |
| Ba 49. | 5 | 0.05 | S. C. (oil)..... | 0 |
| | 5 | .10 | S. C. | 40 |
| | 5 | .25 | S. C. | 100 |
|  | | | | |

TABLE 1.—Preliminary study of acute toxicity for mice of some arsenic and sulphur compounds—Continued

| Compound | Number of mice | Dose (gm. per kilo) | Route | Mortality (percent) |
|--|------------------|--------------------------|--|-------------------------|
| Atoxyl.....  | 10 5 | 0.25 .5 | S. C..... S. C..... | 10 60 |
| Tryparsamide.....  | 5 5 | 1.0 2.0 | S. C..... S. C..... | 0 40 |
| Ba 35.....  | 5 5 5 | 0.25 .60 1.0 | Oral..... Oral..... Oral..... | 0 20 80 |
| Ba 36.....  | 5 5 5 6 | 0.5 1.0 2.0 4.0 | Oral..... Oral..... Oral..... Oral..... | —N 0 0 0 33 |
| Ba 37.....  | 5 5 5 | 0.5 1.0 2.0 | Oral..... Oral..... Oral..... | 0 0 0 |

Acetylation of 4-nitro-4'-aminodiphenylarsinic acid (Ba 29) caused an increase of antistreptococcal action and at the same time a decrease in toxicity of one-half. When administered in amounts close to the tolerated dose, curative effects, with a certain percentage of permanent survivors, could be obtained. This favorable effect of acetylation of arsenic compounds has several counterparts in the field of trypanocidal and spirillocidal derivatives (i. e., arsacatin). By mouth the activity of Ba 29 was approximately the same as equal doses of sulfanilamide, but on subcutaneous injection it was more active.

The corresponding trivalent arsenic derivative was obtained both as an anhydride, 4,4''-dinitro-4',4'''-diacetyldiamino-tetraphenylarsyl-oxide (Ba 31), and as a hydroxy compound, 4-nitro-4'-acetylamino-diphenylarsylhydroxide (Ba 31b). Both forms were approximately twice as active and twice as toxic as the pentavalent compound. Curative effects were seen with 0.025 to 0.05 gm. per kilo (0.5 to 1 mg. per 20-gm. mouse). They were insoluble and were administered

TABLE 2.—Comparative activity of some asymmetric arsenic and sulfur compounds against streptococcal infections in mice

| Number | Compound | Dosage | Num- ber of mice | Deaths in days | | | | | | | | | | | Mortality (percent) | Organism | | |
|---------|--|--|--|----------------|---|---|---|---|---|---|---|---|----|-------|------------------------|----------|--|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11-14 | | | 15-21 | |
| Ba 29 | 4 - acetylamino - 4' - nitrodiphenyl- arsinic acid. 4, 4'- dinitro - 4' - diacetyl-di- methylphenylarsyl fluoride. 4, 4'-aminonitro diphenylsulfone. | { 0.015X2 days subcutaneous. 0.01X2 days subcutaneous. | { 20 | 9 | 8 | 1 | 1 | | | | | | | 1 | 1 | 95 | Streptococcus 995, 10 ⁻⁴ . | |
| Ba 31 | | { 0.015X2 days subcutaneous. 0.01X2 days subcutaneous. | { 20 | 5 | 5 | 4 | | 1 | 2 | | | | | 1 | 1 | 95 | | |
| Ba 35 | | { 0.015X2 days subcutaneous. 0.01X2 days subcutaneous. | { 20 | 2 | 1 | | | | 2 | 3 | | 3 | 3 | 3 | | | 85 | |
| | | { 0.4X2 days subcutaneous. 0.3X2 days subcutaneous. | { 20 | 2 | 2 | | | | | 4 | 1 | | 1 | 3 | 2 | | 75 | |
| | Sulfanilamide. | | 18 | 13 | 3 | | | | | 1 | | | | | | 95 | | |
| Ba 29 | 4 - acetylamino - 4' - nitrodiphenyl- arsinic acid. 4-amino-4'-nitrodiphenylarsinic acid. do. do. do. | { 0.025X4 days subcutane- ous. | { 20 | 3 | 2 | 1 | | 3 | 1 | 3 | | | | 1 | | 70 | Streptococcus 995, 10 ⁻⁴ . | |
| Ba 30 | | { do. | { 20 | 9 | 1 | 1 | 3 | | 3 | | | | | | 1 | 90 | | |
| Ba 31 | | { do. | { 20 | 4 | | 4 | 1 | 3 | | 2 | 1 | | | 1 | 3 | 95 | | |
| Ba 31b. | | { do. | { 20 | 5 | 5 | 2 | | | 2 | | | | | | | 1 | 75 | |
| Ba 34 | Glutathione derivative of Ba 31. 4-amino-4'-nitrodiphenylsulfone. | { 0.01X4 days subcutaneous. 0.025X4 days subcutane- ous. | { 20 | 5 | 4 | | | 1 | 1 | 2 | 2 | 1 | 1 | | | 90 | Streptococcus 995, 10 ⁻⁴ . | |
| Ba 35 | | { 0.4X4 days subcutaneous. | { 20 | | | 1 | | | | | | 1 | 5 | 1 | 3 | 70 | | |
| | Sulfanilamide. | | 20 | | | | 2 | 1 | 3 | 2 | 2 | 1 | 4 | 1 | | 100 | | |
| | Controls. | | 20 | 19 | | | | | | | | | | 1 | | 100 | | |
| Ba 29 | | { 0.05X2 days subcutaneous. | { 10 | 6 | 2 | 1 | | | | | | | | | | 90 | Streptococcus 1686, 10 ⁻⁴ . | |
| Ba 31 | | { 0.05X2 days oral. 0.05X2 days subcutaneous. | { 10 20 | 6 4 | | | 3 | 6 | 4 | 3 | 1 | 1 | | | 1 | 95 | | |
| | | { 0.05X2 days subcutaneous. | { 20 | 20 | | | | | | | | | | | | | 100 | |
| Ba 31 | | | { 0.05X1 day subcutaneous. 0.25X1 day subcutaneous. 0.15X1 day subcutaneous. | { 20 | | | | 2 | 6 | 2 | 4 | | 1 | 1 | | | 85 | Streptococcus 1686, 10 ⁻⁴ . |
| | Sulfanilamide. | { 0.015X1 day subcutaneous. | { 20 | | 1 | 3 | 9 | 6 | | | | | | | | 95 | | |
| | Controls. | | 18 | 15 | 3 | | | | | | | | | | | 100 | | |
| Ba 34 | Glutathione derivative of Ba 31. 4-amino-4'-nitrodiphenylsulfone 4-acetylamino-nitrodiphenylsulfone. | { 0.015X2 days subcutane- ous. | { 20 | 1 | | | | | 2 | 4 | | | 2 | | | 45 | Strepto coccus No. 1686, 10 ⁻⁴ | |
| Ba 35 | | { 0.03X2 days oral. 0.02X2 days oral. | { 20 | 1 | 1 | | | | 5 | 1 | | 1 | 1 | | | 50 | | |
| Ba 36 | | { 0.05X2 days oral. 0.02X2 days oral. | { 20 | | 1 | | | | 6 | 1 | 1 | 1 | | | 1 | | 55 | |

subcutaneously in olive oil. The toxicity of the anhydride was greater orally than subcutaneously, differing in this respect from other compounds in this series.

The soluble glutathione (Ba 34) and cysteine (Ba 42) derivatives¹ of Ba 31 and Ba 31b were prepared. The glutathione derivative was twice as toxic and four times as active as the parent compound. Curative effects against streptococci could be shown with 0.01 to 0.015 gm. per kilo (0.2 to 0.3 mg. per 20-gm. mouse). This represents an activity equal to that of the highly active sulfones. Although the toxicity of the cysteine derivative was less, therapeutic activity was diminished to a greater extent than toxicity (tables 2 and 5).

By further reduction of 4-nitro-4'-aminodiphenylarsinic acid and its acetyl derivative, two arsines were prepared, Ba 46 and Ba 49. As in the case of the arsenic acid, the acetyl derivative was more active and less toxic than the deacetylated compound. The acetylated derivative (Ba 46) was highly insoluble and was poorly absorbed from the site of its subcutaneous injection in oil. Curative effects were seen with 0.1 gm. per kilo, while it was tolerated in twice this dosage (tables 4 and 5).

The activity of the arsenic compounds was characterized by a limited range of dosage. Therapeutic effects which were pronounced with a given dose diminished rapidly when the dose was decreased.

All of the arsenic compounds in this series were tested against a virulent strain of pneumococcus type I, but no appreciable activity was observed with any of them.

The following arsenic compounds were also tested against *Trypanosoma equiperdum* infection in mice: Ba 25, Ba 28, Ba 29, Ba 30, Ba 31, and Ba 42. Only Ba 42 (cysteine derivative) possessed some trypanocidal action, bringing about prolongation of life but no permanent survival when given in one-half the maximum tolerated amount for 3 doses at intervals of 3 days.

SULFUR COMPOUNDS

Included for comparative purposes are those sulfur compounds analogous to the arsenic derivatives in this series (table 2). With the exception of 4-nitro-4'-acetylaminodiphenylsulfone, they have been previously investigated.

4,4'-Diaminodiphenylsulfone is among the most active compounds against streptococcal infections in mice (14, 16, 21, 22). 4-Nitro-4'-aminodiphenylsulfone has been found to be of equal activity and toxicity (5a, 15). Our results are in general agreement with these findings; approximately 0.025 to 0.03 gm. per kilo (0.5 to 0.6 mg. per 20-gm. mouse) represented an effective dose. 4-Nitro-4'-acetylamino-

¹ The chemical structure of these derivatives has not yet been established.

TABLE 3.—*Antistreptococcal action of some arsenic compounds administered orally to mice*

| Number | Compound | Dosage (gm. per kilo) | Num- ber of mice | Deaths in days | | | | | | | | | | | | Mortal- ity (per- cent) | Organism |
|--------|---|-----------------------|------------------------|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|----------------------------------|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11-14 | 15-21 | | |
| Ba 29. | 4-acetyl-amino-4'-nitrodiphenyl- arsinic acid. | 0.15×3 days. | 20 | 1 | --- | 3 | 3 | 2 | 1 | 1 | 1 | --- | 1 | 1 | --- | 70 | Streptococcus No. 1685, 10 ⁻⁴ . |
| Ba 30. | 4-amino-4'-nitrodiphenylarsinic acid. | do. | 20 | --- | 11 | 2 | 1 | 2 | 2 | 1 | --- | --- | --- | --- | --- | 95 | |
| Ba 28. | 4, 4'-diaminodiphenylarsinic acid. | do. | 20 | 20 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| Ba 29. | Controls. | do. | 20 | 20 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | Streptococcus No. 995, 10 ⁻⁴ . |
| Ba 30. | 0.15×4 days. | do. | 20 | 6 | 3 | 1 | 2 | --- | --- | 1 | 1 | --- | --- | 1 | --- | 80 | |
| Ba 28. | do. | do. | 20 | 6 | 3 | 3 | 1 | 1 | --- | --- | --- | --- | --- | --- | --- | 80 | |
| Ba 29. | do. | do. | 20 | 16 | 3 | 1 | --- | --- | --- | --- | --- | --- | --- | --- | --- | 100 | |
| Ba 28. | do. | do. | 20 | 1 | 1 | 3 | 4 | 1 | 2 | 2 | 2 | --- | --- | 1 | --- | 85 | |
| Ba 29. | Sulfanilamide. | do. | 20 | 12 | 4 | 3 | --- | --- | --- | --- | --- | --- | --- | --- | --- | 100 | Streptococcus No. 995, 10 ⁻⁴ . |
| Ba 30. | Controls. | do. | 4 | 1 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 75 | |
| Ba 29. | 0.15×3 days. | do. | 20 | 4 | 4 | 1 | 1 | 2 | 3 | 1 | 1 | --- | --- | 1 | --- | 90 | |
| Ba 30. | do. | do. | 20 | 4 | 7 | 3 | 4 | --- | --- | --- | --- | --- | --- | --- | --- | 100 | Streptococcus No. 995, 10 ⁻⁴ . |
| Ba 28. | do. | do. | 20 | 10 | 3 | 1 | 1 | 1 | 2 | 1 | --- | --- | 2 | 1 | --- | 95 | |
| Ba 29. | Sulfanilamide. | do. | 20 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 80 | |
| Ba 30. | Controls. | do. | 20 | 10 | 4 | 3 | 3 | --- | --- | --- | --- | --- | --- | --- | --- | 100 | |
| Ba 28. | do. | do. | 4 | 2 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 100 | |
| Ba 29. | 0.15×4 days. | do. | 20 | 4 | 4 | 3 | 2 | 3 | 2 | --- | --- | --- | --- | --- | --- | 90 | Streptococcus No. 1685, 10 ⁻⁴ . |
| Ba 30. | do. | do. | 20 | 5 | 8 | 3 | 2 | 2 | --- | --- | --- | --- | --- | --- | --- | 100 | |
| Ba 28. | do. | do. | 20 | 17 | 3 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 100 | |
| Ba 29. | Sulfanilamide. | do. | 20 | 17 | 9 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 80 | |
| Ba 30. | Controls. | do. | 20 | 17 | 2 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 95 | |
| Ba 28. | do. | do. | 5 | 5 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 100 | |

TABLE 4.—Comparative antistreptococcal activity of some arsenic and sulfur compounds

| Number | Compound | Dosage, S. C. (gm. per kilo) | Num- ber of mice | Deaths in days | | | | | | | | | | | | Mortal- ity (per- cent) | Organism |
|--------|---|------------------------------|------------------------|----------------|---|---|---|---|---|---|---|---|----|-------|-------|----------------------------------|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11-14 | 15-21 | | |
| Ba 46 | 4, 4''-diacetyldiamino-4', 4'''-dinitro- tetraphenylarsyl. | 0.1×2 days. | 15 | 1 | 1 | | 2 | | 4 | | 1 | | 1 | 1 | 1 | 80 | Streptococcus No. 995, 10 ⁻⁴ . |
| | Sulfanilamide. | 0.05×1 day. | 15 | | | | | | | | | | | | | 66 | |
| | Controls. | 0.25×1 day. | 15 | 11 | 4 | | | | | | | | | | | 100 | |
| Ba 46. | Deacetylated Ba 46. | 0.035×3 days. | 20 | 10 | 4 | 3 | | | | 1 | | | | | | 90 | Streptococcus No. 995, 10 ⁻⁴ . |
| Ba 49. | Controls. | do. | 20 | 16 | 3 | 1 | | | | | | | | | | 100 | |
| | | | 20 | 18 | 2 | | | | | | | | | | | 100 | |
| Ba 46. | Controls. | 0.05×3 days. | 15 | 2 | 6 | 1 | 3 | | | 1 | | 1 | | 1 | | 100 | Streptococcus No. 1685, 10 ⁻⁴ . |
| | | | 15 | 15 | | | | | | | | | | | | 100 | |
| Ba 33. | 4-nitrophenylarsonic acid. | 0.05×1 day. | 20 | 18 | 2 | | | | | | | | | | | 100 | Streptococcus No. 1685, 10 ⁻⁴ . |
| | Tryparsamide. | 0.5×1 day. | 20 | 17 | 3 | | | | | | | | | | | 100 | |
| | Atoxyl. | 0.2×1 day. | 20 | 16 | 4 | | | | | | | | | | | 100 | |
| | Controls. | 0.1×1 day. | 20 | 16 | 4 | | | | | | | | | | | 100 | |
| Ba 35. | 4-amino-4'-nitrodiphenylsulfone. | 0.0125×4 days (oral). | 20 | 2 | 5 | 3 | 1 | 1 | 4 | 1 | | | | | | 85 | Streptococcus No. 1685, 10 ⁻⁴ . |
| Ba 18. | 4, 4'-diaminodiphenylsulfone. | do. | 20 | 3 | 4 | 4 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 80 | |
| | Controls. | | 20 | 16 | 3 | 1 | | | | | | | | | | 100 | |
| Ba 18. | 4-amino-4'-nitrodiphenylsulfone. | 0.03×3 days (oral). | 20 | 1 | 3 | 3 | 1 | 1 | 4 | 1 | | | | 1 | | 75 | Streptococcus No. 995, 10 ⁻⁴ . |
| Ba 35. | 4-acetylamino-4'-nitrodiphenylsul- fone. | do. | 20 | 3 | 2 | 4 | 1 | 3 | 1 | 2 | 1 | | 1 | 1 | 1 | 85 | |
| Ba 36. | Controls. | | 20 | 3 | 5 | 1 | 3 | 1 | | 2 | | | 1 | | | 85 | |
| | | | 10 | 5 | 3 | | 1 | | | | | | 1 | | | 100 | |

TABLE 5.—Summary of the toxicity and therapeutic activity against streptococci of some arsenic and sulfur compounds (drugs administered subcutaneously unless otherwise stated)

| Number | Compound | M. T. D., gm. per kilo | M. E. D. (strep- tococcus) gm. per kilo | Thera- peutic index |
|--------|--|------------------------------|---|---------------------------|
| Ba 25 | 4,4'-diaminodiphenylarsinic acid | 0.05 | None | 0 |
| Ba 26 | 4,4'-diaminodiphenylarsinic acid (oral) | 3 | do | 0 |
| Ba 27 | 4,4',4'',4'''-tetraaminotetraphenylarsyl oxide | .025 | do | 0 |
| Ba 28 | 4-acetyl amino-4'-nitrodiphenylarsinic acid | 1 | 0.15-0.25 | 1 |
| Ba 29 | 4-acetyl amino-4'-nitrodiphenylarsinic acid (oral) | .05 | Slight | 2 |
| Ba 30 | 4-amino-4'-nitrodiphenylarsinic acid | .25 | do | >> |
| Ba 31 | 4-amino-4'-nitrodiphenylarsinic acid (oral) | .05 | do | 1 |
| Ba 31b | 4,4'-diacetyl diamino-4,4'-dinitrotetraphenylarsyl oxide | .05 | 0.05 | 1 |
| Ba 32 | 4-acetyl amino-4'-nitrodiphenylarsyl hydroxide | .05 | 0.05 | 1 |
| Ba 33 | Glutathione derivative of Ba 31b | .025 | 0.0125 | 2 |
| Ba 34 | Cysteine derivative of Ba 31 | .05 | 0.025-0.05 | 1-2 |
| Ba 42 | 4,4'-diacetyl diamino-4,4'-dinitrotetraphenylarsyl | .2 | 0.1 | 1-2 |
| Ba 46 | 4,4'-diamino-4,4''-dinitrotetraphenylarsyl | .05 | Slight | < |
| Ba 49 | 4-nitrophenyl arsonic acid | .25 | None | 0 |
| Ba 33 | Atoxyl | 1.0 | do | 0 |
| | Tryparsamide | | do | 0 |
| Ba 18 | Sulfanilamide | (oral) 2.5 | 0.4-0.75 | 3.3-6 |
| Ba 35 | 4,4'-diaminodiphenylsulfone | .15 | 0.025 | 6 |
| Ba 36 | 4-amino-4'-nitrodiphenylsulfone | .25 | 0.03 | 8 |
| Ba 37 | 4-acetyl amino-4'-nitrodiphenylsulfone | 2.0-3.0 | 0.03 | 70-100 |
| Ba 19 | 4,4'-diacetyl diaminodiphenylsulfone | 1 | 0.2 | >40 |
| Ba 37 | 4-acetyl amino-4'-nitrodiphenylsulfoxide | >2.0 | 0.2 | >10 |


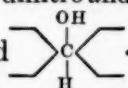
¹ The low acute toxicity of this compound is deceptive since it is only partially absorbed from the alimentary canal. This may also apply to the oral toxicity of other compounds in this series.

diphenylsulfoxide was less active. It is of interest that the corresponding diaminodiphenyl arsenic compounds were inactive while the nitroamino compounds were active.

The favorable effect of acetylation upon the therapeutic action of the 4-nitro-4'-aminodiphenyl arsenic compounds was not to be anticipated from the results with sulfur compounds. Acetylation of sulfanilamide reduces its activity to a trace. Acetylation of 4,4'-diaminodiphenylsulfone reduces its activity several fold, although toxicity is decreased to an even greater extent. Incomplete absorption from the alimentary tract is a factor in the decreased toxicity of this compound (9, 21, 22).

Our results with the asymmetric arsenic compounds led us to study the acetylated derivative of 4-nitro-4'-aminodiphenylsulfone. Our results in mice indicate that acetylation of this compound does not diminish its antistreptococcal activity while it does bring about a decrease in toxicity to approximately one-tenth of the free compound (tables 2, 4, and 5). This derivative possesses a very high therapeutic index against streptococcal infections in mice; while variation in absorption and excretion might account for some of the decrease in toxicity, the fact that the therapeutic activity is not decreased makes this observation of significance. Results in pneumococcal infections in mice were much less marked, and showed no appreciable superiority over the other sulfones in this series.

AROMATIC NITRO AND AMINO COMPOUNDS

Experiments were carried out with a series of 4,4'-diamino, -dinitro and -nitroamino compounds possessing the linkages  and .

In spite of the relatively low toxicity of these compounds no therapeutic activity was observed against streptococcal or pneumococcal infections in mice. These compounds, the benzophenones, and benzhydrols represent a replacement of arsenic or sulfur by carbon.

At the suggestion of one of us (E. E.) some simple nitro- and nitrosobenzene derivatives were investigated. Some activity against pneumococcus infections in mice was observed with p-nitro-benzoic acid.² This compound was more toxic than sulfanilamide but with maximum tolerated doses a prolongation of life was observed which was as great as or greater than the effect of similar doses (by weight) of sulfanilamide. Only rarely, however, did survival occur as a result of therapy. The toxicity by mouth was less than that upon subcutaneous injection, and greater prolongation of life could be obtained by oral administration (tables 6 and 7).

² Since this was written a report of the antistreptococcal and antipneumococcal action of p-nitrobenzoic acid and some esters by R. L. Mayer and C. Oechsli has appeared (Compt. Rend. Soc. Biol., 130:211 (1939)).

TABLE 6.—*Toxicity and antibacterial activity of some benzophenones, benzhydrols, nitro and amino benzoic acids and related compounds*

| Compound | M. T. D., gm. per kilo | Route | Activity |
|---|---------------------------|------------------|------------|
| 4,4'-dinitrodiphenylmethane..... | 2.0 | S. C. (oil)..... | 0 |
| 4,4'-dinitrobenzophenone ¹ | 1.5 | S. C. (oil)..... | 0 |
| 4-amino-4'-nitrobenzophenone ¹ | 1.5 | S. C. (oil)..... | 0 |
| 4,4'-diaminobenzophenone ¹ | .5 | Oral..... | 0 |
| 4,4'-tetramethyldiaminobenzophenone..... | 2.0 | S. C. (oil)..... | 0 |
| 4,4'-diaminobenzhydrol ¹ | .5 | S. C. (oil)..... | 0 |
| 4,4'-diaminobenzhydrol ¹ | 1.0 | Oral..... | 0 |
| 4,4'-tetramethyldiaminobenzhydrol..... | 1.0 | Oral..... | 0 |
| 2-nitrobenzoic acid..... | 0.5 | S. C., oral..... | 0 |
| 3-nitrobenzoic acid..... | .5 | S. C., oral..... | 0 |
| 4-nitrobenzoic acid..... | .5 | S. C..... | 1 Moderate |
| 4-nitrobenzoic acid..... | 1.0 | Oral..... | 1 Moderate |
| 1,3,5-trinitrobenzoic acid..... | .3 | S. C..... | 0 |
| 4-nitrobenzamide..... | 1.0 | S. C. (oil)..... | 1 Trace |
| 4-nitrobenzhydrazide..... | .03 | S. C. (oil)..... | 0 |
| 4-nitrobenzoic acid ¹ | .08 | S. C..... | 0 |
| 4-hydroxylaminebenzoic acid ¹ | .5-1.0 | S. C..... | 0 |
| 4-aminobenzoic acid..... | 4.0 | S. C..... | 0 |
| 4-aminobenzoic acid..... | 2.0-4.0 | Oral..... | 0 |
| 4,4'-azoxybenzoic acid ¹ | .5-1.0 | S. C..... | 0 |
| 4,4'-azoxybenzoic acid ¹ | 1.0 | Oral..... | 0 |
| 4,4'-azobenzoic acid ¹ | .2 | S. C..... | 0 |
| 4,4'-azobenzoic acid ¹ | .5 | Oral..... | 0 |
| 4-nitrobenzaldehyde..... | .5 | S. C. (oil)..... | 1 Moderate |
| 4-nitrobenzaldehyde..... | 1.0 | Oral..... | 1 Moderate |
| 4-nitrobenzal bromide..... | 1.0 | S. C. (oil)..... | 1 Moderate |
| 4-nitrobenzal bromide..... | .6-1.0 | Oral..... | 1 Moderate |
| 4-nitrobenzyl chloride..... | .5 | S. C. (oil)..... | 1 Slight |
| 4-nitrobenzyl chloride..... | .5-1.0 | Oral..... | 1 Slight |
| 4-nitrotoluene..... | 1.0 | Oral..... | 1 Moderate |
| 4-nitroaniline..... | 1.0 | Oral..... | 0 |
| 4-nitrodiphenylamine..... | .5-1.0 | S. C. (oil)..... | 0 |
| 4-nitroacetanilide..... | .5 | S. C. (oil)..... | 0 |
| 4-nitrophenylglycine..... | .5 | S. C..... | 0 |
| 1-nitro-3-methoxyphenol..... | .5 | S. C..... | 0 |
| 1-nitro-4-methoxyphenol (4-nitroanisol)..... | 2.0 | S. C. (oil)..... | 0 |
| 1,4-dinitrobenzene..... | .05 | Oral..... | 0 |
| 4-nitrodiphenyl..... | 2.0 | S. C. (oil)..... | 0 |
| 4,4'-dinitrodiphenyl..... | 2.0 | S. C. (oil)..... | 0 |
| 4,4'-dinitroamineazobenzene..... | 1.0 | S. C., oral..... | 0 |
| 4,4'-dinitrodiphenyl ether..... | 1.0 | S. C. (oil)..... | 0 |
| 4-nitrosophenol sodium..... | 0.125 | S. C..... | 0 |
| 4-nitrosodimethylaniline..... | .025 | S. C. (oil)..... | 0 |
| 4-nitrosodiphenylamine..... | .05 | S. C. (oil)..... | 0 |
| Diphenyl nitrosamine..... | .5 | S. C. (oil)..... | 0 |
| Diphenyl nitrosamine..... | 1.0 | Oral..... | 0 |

¹ Prepared by H. B.² Prolongation of life, especially against pneumococcus.

4-Nitrobenzoic acid differed from compounds of the sulfur and arsenic series in that activity was less marked upon streptococcal than upon pneumococcal infections. With maximum doses some prolongation of life was observed but the effect was much weaker than that obtained with similar doses of sulfanilamide.

Experiments were also carried out upon a series of compounds related to 4-nitrobenzoic acid. Substitution of the COOH group by CHO, CH₃, or CHBr₂ did not greatly affect the activity; 4-nitrobenzyl chloride (CH₂Cl) was less active (tables 6 and 7).

Substitution of COOH by CONH₂ (4-nitrobenzamide) decreased activity to a trace; substitution by CONH.NH₂ (4-nitrobenzhydrazide) abolished activity, but only small doses could be given because of toxicity. Replacement of the COOH group by NO₂ (1-4-dinitroben-

TABLE 7.—*The action of 4-nitrobenzoic acid and related compounds upon pneumococcal infections in mice*

| Compound | Dosage (gm. per kilo) | Number of mice | Deaths in days | | | | | | | | | | Mortality (percent) | Organism |
|----------------------------|--|----------------|----------------|----|----|----|---|---|---|---|---|----|---------------------|--|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | |
| 4-nitrobenzoic acid..... | {0.5 x 2 days oral. 0.25 x 2 days oral. | 15 | 1 | 1 | 2 | 10 | | | | | | | 93 | Pneumococcus Mull. I, 10 ⁻⁴ |
| Do..... | {0.5 x 1 day S. C. 0.25 x 3 days S. C. | 15 | | 5 | 3 | 6 | 1 | | | | | | 100 | |
| Sulfanilamide..... | {0.5 x 2 days oral. 0.25 x 1 day oral. | 15 | 1 | 11 | 3 | | | | | | | | 100 | |
| Controls..... | | 15 | 5 | 10 | | | | | | | | | 100 | |
| 4-nitrobenzoic acid..... | {0.5 x 2 days oral. 0.3 x 2 days oral. | 15 | | 3 | 3 | 7 | 2 | | | | | | 100 | Pneumococcus Mull. I, 10 ⁻⁴ |
| Do..... | {0.5 x 1 day S. C. 0.3 x 3 days S. C. | 15 | 6 | 5 | 2 | | 2 | | | | | | 100 | |
| Sulfanilamide..... | {0.5 x 2 days oral. 0.3 x 2 days oral. | 15 | 4 | 9 | 1 | 1 | | | | | | | 100 | |
| Controls..... | | 15 | 8 | 7 | | | | | | | | | 100 | |
| 4-nitrobenzoic acid..... | {0.5 x 3 days S. C. 0.5 x 3 days S. C. | 20 | 8 | 2 | 10 | | | | | | | | 100 | Pneumococcus Lederle I, 10 ⁻⁴ |
| Do..... | | 20 | | 4 | 9 | 3 | 3 | | | | | | 100 | |
| Sulfanilamide..... | | 20 | 18 | 2 | | | | | | | | | 100 | |
| Controls..... | | | | | | | | | | | | | 100 | |
| 4-nitrobenzoic acid..... | {0.75 x 1 day oral. 0.5 x 2 days oral. | 12 | | 5 | 7 | | | | | | | | 100 | Pneumococcus Lederle I, 10 ⁻⁴ |
| Do..... | | 15 | | 5 | 9 | 1 | | | | | | | 100 | |
| Sulfanilamide..... | {0.5 x 2 days oral. 0.25 x 2 days oral. | 15 | 2 | 4 | 7 | 2 | | | | | | | 100 | |
| Controls..... | | 15 | 6 | 7 | 2 | | | | | | | | 100 | |
| 4-nitrobenzal bromide..... | {0.5 x 2 days oral. 0.25 x 2 days oral. | 15 | | 5 | 9 | 1 | | | | | | | 100 | Pneumococcus Lederle I, 10 ⁻⁴ |
| Do..... | | 15 | | 5 | 9 | 1 | | | | | | | 100 | |
| Sulfanilamide..... | {0.3 x 3 days oral. 0.3 x 3 days oral. | 15 | 2 | 12 | 1 | | | | | | | | 100 | |
| Controls..... | | 15 | 12 | 3 | | | | | | | | | 100 | |
| 4-nitrotoluene..... | {0.5 x 2 days oral. 0.25 x 1 day oral. | 15 | 5 | 6 | 2 | 2 | | | | | | | 100 | Pneumococcus Lederle I, 10 ⁻⁴ |
| Do..... | {0.25 x 1 day S. C. 0.25 x 1 day oral. | 15 | 5 | 9 | 1 | | | | | | | | 100 | |
| Sulfanilamide..... | | 10 | 1 | 7 | 1 | | | | | | | | 100 | |
| Controls..... | | 15 | 12 | 3 | | | | | | | | | 100 | |

zene), NH_2 (4-nitroaniline), $\text{NH}.\text{CH}_2.\text{COOH}$ (4-nitrophenylglycine), $\text{NH}.\text{C}_6\text{H}_5$ (4-nitrodiphenylamine), $\text{NH}.\text{COCH}_3$ (4-nitroacetanilide), $\text{O}.\text{CH}_3$ (4-nitroanisole), C_6H_5 (4-nitrodiphenyl), or AsO_3H_2 (4-nitrophenylarsinic acid) abolished activity in tolerated doses. The inactivity of the benzophenones and benzhydrols has already been referred to (table 6).

Reduction of the nitro group of 4-nitrobenzoic acid abolished activity. Various stages of reduction were represented by 4-nitroso-, azoxy-, azo-, hydroxylamino-, and aminobenzoic acid, all of which were inactive.

Mayer and Oechsli (10, 23) have investigated the various products of oxidation of the amino group of sulfanilamide. Their series included the corresponding 4-nitro-, 4-nitroso-, azoxy-, azo-, 4-hydroxylamino-, and 4-aminobenzenesulfonamide. They report activity for all members of the series except the azo compound; 4-nitrobenzenesulfonamide was more active but also more toxic than the amino derivative (sulfanilamide). The benzoic acid derivatives differ, therefore, from the sulfonamide series in that activity has been observed only for the nitro compound.

Changes of the position in the benzene ring to ortho- and meta-nitrobenzoic acid destroyed activity. 1-3-5-Trinitrobenzoate was also inactive.

Other related compounds, all inactive, were 1-nitro-3-methoxyphenol, 4-nitrosophenol sodium, 4,4'-dinitroaminoazobenzene, 4-nitrosodiphenylamine, diphenylnitrosoamine, 4-nitrosodimethylaniline, 4,4'-dinitrodiphenyl, 4,4'-dinitrodiphenyl ether (table 6).

DISCUSSION

The interest in the compounds reported in this paper lies in the relationship of their structure to their antibacterial action. Chemotherapeutic activity of two different types of compounds containing no sulfur also affords new possibilities of chemical approach to the problem. Some of the arsenic compounds with a structure corresponding to the highly active diphenyl sulfur compounds were found to possess a high degree of activity, thus giving evidence that sulfur is not essential to therapeutic action. However, of the active arsenic compounds so far obtained, the toxicity has been such that the effective dose closely approaches the toxic dose.

Acetylation of the 4-nitro-4'-aminodiphenylarsinic acid did not diminish therapeutic activity, although it did decrease toxicity. This was also true for the corresponding arsine, as well as the asymmetric 4-nitro-4'-aminodiphenylsulfone. This is evidence that a nitro group in certain structural arrangements may be more important than a free amino group. Other evidence to this effect was shown in that 4-nitro-4'-aminodiphenylarsinic acid (Ba 30) was active while the correspond-

ing diamino compound (Ba 25) was inactive. Likewise, some antibacterial activity was found for p-nitrobenzoic acid and related compounds, while the corresponding p-amino derivative, although of lower toxicity, was devoid of activity. Buttle and co-workers (15) reported a trace of antistreptococcal action for 4,4'-dinitrodiphenylmethane, while the amino compound was inactive. In our experiments no appreciable activity was observed with the former compound.

The difficulties, however, must be pointed out in separating the activity of a certain radical from that of the rest of the molecule. As examples may be cited the facts that the diaminodiphenylarsinic compounds are inactive while the corresponding sulfur compounds are active; 4-aminobenzoic acid is inactive while 4-aminophenylsulfonamide is active; 4-nitrophenylsulfonamide is more active than the amino compound but 4,4'-dinitrodiphenylsulfone is less active than 4,4'-diaminodiphenylsulfone.

Mayer (10) found p-nitrobenzenesulfonamide five times as active as the amino compound (sulfanilamide), while p-hydroxylaminobenzene sulfonamide was highly bactericidal *in vitro* but only slightly active in the body. Mayer suggested (23) that the hydroxylamino compound is the active derivative formed from sulfanilamide in the body; he explained its slight action *in vivo* on a basis of its rapid oxidation at the site of injection.

In our experiments any reduction of the nitro group of 4-nitrobenzoic acid abolished activity. While the greater toxicity of the nitroso compound might have reduced the tolerated dose to where no effect was obtained, this would not account for the inactivity of the hydroxylamino, the amino, the azoxy, and the azo derivatives. The importance of the carbonyl (CO) group in the para position is also seen in that only those compounds containing this or a closely related group were active.

SUMMARY

Two new types of chemical compounds have been found to possess antibacterial properties.

(a) The asymmetric 4-nitro-4'-aminodiphenylarsinic acid and corresponding arsyloxide and arsine were active against streptococcal infections in mice. Acetylation increased activity and lowered toxicity but the effective doses were close to the toxic doses. The symmetric 4,4'-diaminodiphenylarsinic acid and arsyloxide were inactive.

(b) 4-Nitrobenzoic acid, the aldehyde, 4-nitrobenzal bromide, 4-nitrobenzyl chloride and 4-nitrotoluene possessed some activity, particularly against pneumococcal infections in mice.

The various reduction products of 4-nitrobenzoic acid were inactive, as were likewise the symmetric and asymmetric benzophenones and benzhydrols, and a series of other nitro and nitroso compounds.

Some sulfur compounds were included for their comparative activity. It was found that acetylation of 4-nitro-4'-aminodiphenylsulfone decreased its toxicity without decreasing its antistreptococcal activity. This compound possesses a very high therapeutic index against streptococcal infections in mice.

The fact that antibacterial properties have been demonstrated for some asymmetric arsenic compounds containing a nitro group, and also for some simple aromatic nitro compounds, demonstrates the importance of the nitro group and also that sulfur is not essential to therapeutic activity.

Chemical Supplement

By HUGO BAUER

4,4'-Diaminodiphenylarsinic acid (Ba 25) was prepared according to L. Benda (24) and F. L. Pyman and W. C. Reynolds (25).

4,4',4'',4'''-Tetraaminotetraphenylarsyloxide (Ba 28) was prepared by reduction of 4,4'-diaminodiphenylarsinic acid in hydrochloric acid solution by means of sulfur dioxide, employing iodine as a catalyst. The tetrahydrochloride thus obtained yielded the free amino compound in fine needles upon treatment with ammonia. Melting range 85-90° C.

4-Nitro-4'-acetylaminodiphenylarsinic acid (Ba 29).—This compound was formed by the action of diazo-p-nitroaniline upon p-acetylaminophenylarsinoxide in a dilute solution of acetic acid. The colorless needles melted at 258° C. Analysis: $C_{14}H_{13}O_5N_2As$. Calculated As 20.58 percent; found As 20.43 percent.

4-Nitro-4'-aminodiphenylarsinic acid (Ba 30).—The corresponding acetyl compound was deacetylated by heating with concentrated hydrochloric acid. Yellow needles. M. P. 239° C. Analysis: $C_{12}H_{11}O_4N_2As$. Calculated As 23.26 percent; found As 23.61 percent.

4,4''-Dinitro-4',4'''-diacetyldiaminotetraphenylarsyloxide (Ba 31).—4-Nitro-4'-acetylaminodiphenylarsinic acid was reduced with sulfur dioxide and a trace of iodine in a mixture of glacial acetic acid and hydrochloric acid. The compound was precipitated with water and crystallized from benzene. The pale yellow needles contained benzene of crystallization. Melting range 95-99° C. Analysis: $C_{28}H_{24}O_7N_4As_2 + 2C_6H_6$. Calculated As 17.97 percent; found As 18.28 percent.

4-Nitro-4'-acetylaminodiphenylarsylhydroxide (Ba 31b).—The corresponding arsyloxide (Ba 31) was dissolved in a solution of dilute sodium hydroxide and dilute acetic acid was added. The hydroxide crystallized in colorless needles which showed no sharp melting point, but softened at about 70° C. Analysis: $C_{14}H_{13}O_4N_2As$. Calculated As 21.53 percent; found As 20.89 percent.

4-Nitrophenylarsonic acid (Ba 33).—For preparation see H. Bart (26).

4,4''-Dinitro-4',4'''-diacetyldiaminotetraphenylarsyloxide + glutathione (Ba 34).—Equal parts of the components were dissolved in a small amount of alcohol along with a little water, and warmed to about 40° C. for 5 minutes. The mixture was evaporated in a vacuum desiccator.

4-Nitro-4'-acetylaminodiphenylarsylhydroxide + cysteine (Ba 42).—A mixture of the components containing an excess of cysteine was prepared as described for the glutathione preparation. The resulting product was not further investigated chemically.

4,4''-Dinitro-4',4'''-diacetyldiaminotetraphenyldiarsyl (Ba 46).—4-Nitro-4'-acetylaminodiphenylarsinic acid in an acetone solution was reduced with hypophosphorous acid containing a trace of potassium iodide. Yellow powder. Analysis: $C_{28}H_{24}O_8N_4As_2$. Calculated As 22.63 percent; found As 22.65 percent.

4,4''-Dinitro-4',4'''-diaminotetraphenyldiarsyl (Ba 49).—The reduction of 4-nitro-4'-aminodiphenylarsinic acid was made with hypophosphorous acid in the presence of potassium iodide. Orange powder. Analysis: $C_{24}H_{20}O_4N_4As_2$. Calculated As 25.92 percent; found 25.22 percent.

4-Nitro-4'-aminodiphenylsulfone (Ba 35).—The acetyl derivative (Ba 36) was deacetylated by heating with a mixture of equal parts of concentrated hydrochloric acid and alcohol for one-half hour. The hydrochloride thus obtained yielded the free base upon treatment with ammonia; it was recrystallized from alcohol. Yellow needles, M. P. 172° C. Analysis: $C_{12}H_{10}O_4N_2S$. Calculated S 11.53 percent; found S 11.67 percent. (See Buttle et al. (15).)

4-Nitro-4'-acetylaminodiphenylsulfone (Ba 36).—4-Nitro-4'-aminodiphenylsulfide (F. Kehrmann and E. Bauer (27)) was acetylated. Ten gm. of the acetyl compound were dissolved in 100 cc. of glacial acetic acid, 5 cc. of 30 percent hydrogen peroxide added, and the mixture boiled for one-half hour. Following the addition of water the solution was cooled. Nine gm. of yellowish crystals which separated out were recrystallized from alcohol. M. P. 223° C. Analysis: $C_{14}H_{12}O_5N_2S$. Calculated S 10.01 percent; found 10.13 percent.

4-Nitro-4'-acetylaminodiphenylsulfoxide (Ba 37).—Sixty gm. of 4-nitro-4'-acetylaminodiphenylsulfide were dissolved in 600 cc. of glacial acetic acid, 27 cc. of 30 percent hydrogen peroxide added, and the mixture heated at 100° C. for 3 hours. Upon addition of water crystals separated which were recrystallized from alcohol. Thirty-nine gm. of yellowish needles were obtained which melted at 212° C. Analysis: $C_{14}H_{12}O_4N_2S$. Calculated S 10.54 percent; found 10.53 percent.

4,4''-Dinitrobenzophenone (Ba 48).—For preparation see W. Staedel (28).

4,4'-Diaminobenzophenone (Ba 50).—For preparation see W. Staedel and E. Sauer (29).

4-Nitro-4'-aminobenzophenone (Ba 55).—This compound, not previously described, was prepared by partial reduction of 4, 4'-dinitrobenzophenone with alcoholic ammonium sulfide. Orange needles crystallized from alcohol. M. P. 179° C. Analysis: $C_{13}H_{10}O_3N_2$. Calculated N 11.57 percent; found 11.65 percent.

4, 4'-Diamino benzhydrol (Ba 51).—For preparation see H. Wichelhaus (30).

4-Hydroxylaminobenzoic acid (Ba 54).—4-Nitrobenzoic acid, in the form of its barium salt, was reduced with zinc dust in the presence of ammonium chloride, according to the method of E. Bamberger and F. L. Pyman (31). White needles were obtained with no melting point, but which showed decomposition beginning at about 170–175° C. This compound reduced Fehling's solution at room temperature.

Analysis: $C_7H_7O_3N$. Calculated N 9.15 percent; found 8.85 percent.

4-Nitrosobenzoic acid (Ba 53).—4-Hydroxylaminobenzoic acid was oxidized with ferric chloride; a yellow amorphous precipitate was formed. With diphenylamine sulfuric acid reagent a deep red color is produced. The compound has been described previously by F. I. Alway (32).

p-Azoxybenzoic acid (Ba 45).—*p-Azobenzoic acid* (Ba 44). For preparation see G. Bachrach and R. Weinstein (33).

REFERENCES

- (1) Tréfouël, J., Nitti, F., and Bovet, D.: Activité du p-aminophénylsulfamide sur les infections streptococciques expérimentales de la souris et du lapin. *Compt. rend. Soc. de Biol.*, **120**: 756 (1935).
- (2) Tréfouël, J., Nitti, F., and Bovet, D.: Chimiothérapie des infections streptococciques par les dérivés du p-aminophénylsulfamide. *Ann. Inst. Pasteur*, **58**: 30 (1937).
- (3) Buttle, G. A., Gray, W. H., and Stephenson, D.: Protection of mice against streptococcal and other infections by p-aminobenzenesulphonamide and related substances. *Lancet*, **1**: 1286 (1936).
- (4) Fourneau, E., Tréfouël, J., Nitti, F., and Bovet, D.: Chimiothérapie des infections streptococciques par les dérivés du p-aminophénylsulfamide. *Compt. rend. Soc. de Biol.*, **122**: 258, 652 (1936).
- (5) Fourneau, E., Tréfouël, J., Nitti, F., and Bovet, D.: (a) Rapport entre la constitution chimique et l'activité thérapeutique antimicrobienne des dérivés organiques du soufre. *Bull. de l'Acad. de Med.*, **118**: 210 (1937).
(b) Action antistreptococcique des p-aminophényl alcoylsulfones et de quelques dérivés sulfurés voisins. *Compt. rend. Soc. de Biol.*, **127**: 393 (1938).
- (6) Goissedet, P., Despois, R., Gaillot, P., and Mayer, R. L.: De l'action du radical sulfamide, SO_2NH_2 sur l'infection streptococcique expérimentale de la souris. *Compt. rend. Soc. de Biol.*, **121**: 1082 (1936).
- (7) Gley, P.: Action antistreptococcique de certaines dérivés sulfurés organiques. *Compt. rend. Acad. de Sc.*, **204**: 1907 (1937).
- (8) Girard, A., Ray, A., and Richard, G.: Antimicrobial action of some aromatic compounds. *Nature*, **140**: 283 (1937).
- (9) Bauer, H., and Rosenthal, S. M.: Studies in chemotherapy. VII. Some new sulfur compounds active against bacterial infections. *Pub. Health Rep.*, **53**: 40 (1938). See also Bauer, H.: *J. Am. Chem. Soc.*, **61**: 613 (1939).

- (10) Mayer, R. L., and Oechslin, C.: Antistreptococciques. *Compt. rend. Acad. de Sc.*, **205**: 181 (1937).
- (11) Mietzsch, F.: Zur Chemotherapie der bakteriellen Infektionskrankheiten. *Bericht. d. Deutsch. Chem. Gesellsch.* **71**: (Abt. A) 15 (1938).
- (12) Whitby, L. E. H.: Chemotherapy of pneumococcal and other infections with 2-(p-aminobenzenesulphonamido) pyridine. *Lancet*, **1**: 1210 (1938).
- (13) Crossley, M. L., Northey, E. H., and Hultquist, M. E.: Sulfanilamide derivatives, I, II, and III. *J. Am. Chem. Soc.*, **60**: 2217, 2222, and 2225 (1938).
- (14) Buttle, G. A. H., Stephenson, D., Smith, S., Dewing, T., and Foster, G. E.: The treatment of streptococcal infections in mice with 4,4'-diaminodiphenylsulfone. *Lancet*, **1**: 1331 (1937).
- (15) Buttle, G. A. H., Dewing, T., Foster, G. E., Gray, W. H., Smith, S., and Stephenson, D.: The action of substances allied to 4: 4'-diaminodiphenylsulfone in streptococcal and other infections in mice. *Biochem. J.*, **32**: 1101 (1938).
- (16) Fourneau, E., Tréfouël, J., Nitti, F., and Bovet, D.: Action antistreptococciques des dérivés sulfurés organiques. *Compt. rend. Acad. de Sc.*, **204**: 1763 (1937).
- (17) Levaditi, C., and Vaisman, A.: Chimiothérapie antiendotoxique. *Ann. de l'Inst. Pasteur*, **61**: 635 (1938).
- (18) Marshall, E. K., Cutting, W. C., and Cover, W. L.: The absorption and excretion of certain sulfanilamide derivatives. *Bull. Johns Hopkins Hosp.*, **63**: 318 (1938).
- (19) Rosenthal, S. M.: Studies in chemotherapy. VIII. Some toxic effects of repeated administration of sulfanilamide and sulfanilyl sulfanilamide ("di-sulfanilamide") to rabbits and chickens. *Pub. Health Rep.*, **54**: 95 (1939).
- (20) Kolmer, J. A., Brown, H., and Raiziss, G. W.: The chemotherapy of experimental streptococcus infections in rabbits with special reference to pyridine compounds and Prontosil soluble. *J. Pharm. and Exp. Therap.*, **61**: 253 (1937).
- (21) Raiziss, G. W., Severac M., Moetsch, J. C., and Clemence, L. W.: Therapeutic effect of 4,4'-diamino-diphenyl-sulfone, corresponding sulfide and acetyl derivatives in streptococcal infection. *Proc. Soc. Exp. Biol. and Med.*, **39**: 339 (1938).
- (22) Feinstone, W. H., Bliss, E. A., Ott, E., and Long, P. H.: Observations concerning the toxicity, absorption and therapeutic effects of sulfanilamide and certain related organic sulfur containing compounds in experimental infections in mice. *Bull. Johns Hopkins Hosp.*, **62**: 565 (1938).
- (23) Mayer, R. L.: Recherches sur le mécanisme de l'action antistreptococcique de l'aminobenzènesulfamide et ses dérivés. *Bull. de l'Acad. de Med.*, **117**: 727 (1938).
- (24) Benda, L.: Über sekundäre aromatische Arsinsäuren. *Bericht. d. Deutsch. Chem. Gesellsch.*, **41**: 2367 (1908).
- (25) Pyman, F. L., and Reynolds, W. C.: Aromatic arsonic and arsinic acids. *J. Chem. Soc.*, **93**: 1180 (1908).
- (26) Bart, H.: Über die Synthese aromatischer Arsinsäuren. *Liebigs Ann. Chemie*, **429**: 55 (1922).
- (27) Kehrman, F., and Bauer, E.: Über die Einwirkung von Schwefelnatrium auf 1,4-Nitrochlorbenzol. *Bericht. d. Deutsch. Chem. Gesellsch.*, **29**: 2362 (1896).
- (28) Staedel, W.: Untersuchungen über Ketone der aromatischen Reihe. *Liebigs Ann. Chemie*, **194**: 307 (1878). (See also p. 370.)
- (29) Staedel, W., and Sauer, E.: Über Dinitrobenzophenon und Dioxybenzophenon. *Bericht. d. Deutsch. Chem. Gesellsch.*, **11**: 1747 (1878).
- (30) Wichelhaus, H.: Zur Kenntnis der Diamidobenzophenone. *Bericht. d. Deutsch. Chem. Gesellsch.*, **22**: 988 (1889).
- (31) Bamberger, E., and Pyman, F. L.: Reduktion der o-Nitrobenzoesäure und ihrer Ester. *Bericht. d. Deutsch. Chem. Gesellsch.*, **42**: 2297 (1909).
- (32) Alway, F. J.: The preparation of aromatic nitroso compounds. *Am. Chem. J.*, **32**: 385 (1904).
- (33) Bachrach, G., and Weinstein, R.: A differential reduction of the nitro group by means of glucose. *Rec. Trav. Chim., Pays-Bas*, **54**: 931 (1935).

VARIETIES OF MEXICAN TYPHUS STRAINS

By M. RUIZ CASTANEDA and ROBERTO SILVA, *Typhus Laboratory, Department of Medical Research, General Hospital, Mexico City*

In 1929 one of us (1) isolated two strains of typhus from patients during a short-lived epidemic occurring in a village near Mexico City. The strains failed to produce the characteristic scrotal swelling reaction with the regularity observed by Mooser (2) in his Mexican strains. One of the strains produced scrotal reaction in two guinea pigs out of 26 serial transfers, the other one showed no scrotal reaction in 25 generations; then by transfer into human lice by the Weigl method and inoculation of the ground lice into guinea pigs, the swelling of the scrotum was established with regularity for a few generations before discontinuing the strain. The isolation of nonorchitic strains in Mexico, before the report of Neil in 1917 and the studies of Mooser in 1928, seems to have been the rule, because the descriptions conform with those of Nicolle in his first communications. The discovery of Dyer, Rumreich, and Badger (3), in rat fleas, and by Mooser, Castaneda, and Zinsser (4), in the brains of rats of a rickettsial disease similar to the Wilmington and Mooser strains of typhus, was taken as a proof that the New World typhus has a murine origin. The non-orchitic strains isolated in Mexico were considered by Nicolle (5) as intermediates between the murine and the Old World typhus.

In 1934, Mooser, Varela, and Pils (6) obtained 5 nonorchitic strains from patients during a typical epidemic of typhus. In accordance with the opinion of Nicolle, these authors applied the name "epidemic" to their strains and also considered them as intermediates between murine and Old World typhus. They established a subdivision of the Mexican typhus, separating it into "endemic" and "epidemic" strains, corresponding to murine and Europeanlike strains, respectively.

During the past 2 years the typhus incidence in Mexico City has been low if we compare it with previous years. From the cases brought to the General Hospital we isolated several strains of typhus which we consider sufficiently interesting to describe in the present paper.

METHODS AND MATERIALS

Forty-six patients in whom a diagnosis of typhus fever was established by clinical and serological data, were bled from the 4th to the 13th day of the disease and 5 cc. of this blood was injected by intraperitoneal route into a rat in each case. We used rats for the first animal transfer following the experience of Mooser, who obtained better results with these animals than by direct inoculation into guinea pigs. Most of the rats were killed from the fifteenth to the twentieth day after the injection; a few were killed later. The

brains were emulsified in saline and injected into male guinea pigs, which were observed daily in order to note the appearance of fever or the scrotal reactions. When the inoculated guinea pigs developed febrile reactions suggestive of the typhus infection, the animals were killed and the brain emulsions transferred to new guinea pigs, usually on the 5th day of the fever. The animals were castrated under ether anesthesia when scrotal swelling was found, and the tunica vaginalis was first smeared for microscopical examination and then washed with salt solution and the washings were injected intraperitoneally into new guinea pigs. Part of the guinea pig brain not used for inoculation was fixed and stained for the study of typhus lesions. The newly isolated strains were submitted to cross-immunity tests, the recovered animals being reinoculated with tunica washings from guinea pigs infected with our "L" orchitic strain.

All strains in which the diagnosis of typhus was established by the finding of rickettsiae in the tunica, typhus lesions in the brain, and by cross-immunity tests were discontinued. Some other strains were lost after one or two transfers in guinea pigs, the last of which did not present fever or swelling but showed immunity when reinoculated with the orchitic "L" strain. The results were considered negative when no fever or swelling was observed in the guinea pigs injected with rat brain and the animals developed typhus fever when reinoculated with the "L" strain. The investigation of the survival of the strain in mice through successive transfers was made in a manner similar to that followed by Savor and Velasco (7). Tunica or brain emulsions from guinea pigs infected with the strain to be tested were injected in amounts of 2 cc. into three mice by intraperitoneal route and transfers were made at 10-day intervals from mice to mice and into one guinea pig.

In staining the smears of the tunica vaginalis and preparing brain sections for the search for typhus lesions we followed the methods described in our previous publications.

ISOLATION OF TYPHUS STRAINS FROM PATIENTS

From October 1936 to January 1938, 69 patients suffering from typhus fever were admitted to the General Hospital of Mexico City. No attempts were made to isolate typhus strains from cases arriving after the thirteenth day of the disease.

In table 1 is indicated the monthly distribution of typhus patients admitted to the service, the number of cases suitable for rat inoculation, the strains of typhus isolated after transfer to guinea pigs, and those which were lost by premature death of the rats from intercurrent infections or because the guinea pigs did not react to the rat brain inoculation. Forty-six of these cases were bled for rat inocula-

tion, from which 20 typhus strains were recovered and many of these were established in guinea pigs for several generations. Disregarding the 8 cases lost by premature death of the rats, the table shows that from 38 cases of typhus, in more than 50 percent the disease was successfully transferred to laboratory animals by the rat to guinea pig method.

TABLE 1.—*Strains isolated from typhus patients*

| Month | Typhus cases admitted to the hospital | Cases transferred into rats | Rats lost before ready for transfer into guinea pigs | Guinea pigs which were negative to inoculation | Number of typhus strains obtained in guinea pigs |
|----------------|---------------------------------------|-----------------------------|--|--|--|
| 1936 | | | | | |
| October..... | 4 | 2 | 0 | 1 | 1 |
| November..... | 1 | 1 | 0 | 0 | 1 |
| December..... | 1 | 1 | 0 | 0 | 1 |
| 1937 | | | | | |
| January..... | 3 | 2 | 0 | 1 | 1 |
| February..... | 6 | 3 | 0 | 2 | 1 |
| March..... | 4 | 3 | 1 | 1 | 1 |
| April..... | 1 | 1 | 0 | 0 | 1 |
| May..... | 3 | 2 | 0 | 2 | 0 |
| June..... | 2 | 1 | 1 | 0 | 0 |
| July..... | 6 | 3 | 1 | 2 | 0 |
| August..... | 9 | 8 | 0 | 3 | 5 |
| September..... | 9 | 4 | 0 | 2 | 2 |
| October..... | 5 | 3 | 1 | 1 | 1 |
| November..... | 5 | 4 | 3 | 1 | 0 |
| December..... | 3 | 3 | 1 | 1 | 1 |
| 1938 | | | | | |
| January..... | 7 | 5 | 0 | 1 | 4 |
| Total..... | 69 | 46 | 8 | 18 | 20 |

PROPERTIES OF 20 MEXICAN TYPHUS STRAINS

The data concerning the typhus strains from 20 patients is summarized in table 2. It was apparent that the severity of the disease had no influence on its transmission to laboratory animals. Most of the strains were obtained before the tenth day of the disease, and in two cases 1 or 2 days later. No attempts were made after the thirteenth day. The transfer of the infection from rats to guinea pigs was characterized by the appearance of fever, and with strain "L" and in cases 13, 28, and 42 a more or less pronounced swelling of the scrotum was also apparent, which only in strain "L" remained a constant feature of the infection. However, in strain No. 42 the scrotal reaction reappeared in some of the subsequent transfers. Of the remaining strains, nonorchitic in the first transfer, No. 5 became orchitic and the swelling was transmitted for several generations by using tunica washings or brain emulsions for the inoculations. Several strains were lost accidentally or by inapparent typhus infections; others were carried for a sufficient number of transfers to be classified according to their clinical features.

Considering the scrotal swelling as a constant sign of the murine type of typhus we may say that from our 20 strains 2 were murinelike,

because the local reaction was transmitted in from 11 to 112 generations. One of these strains was discontinued in order to save animals, but the other one is still going on and has been successfully used in the elaboration of typhus vaccine and typhus antiserum. Eight strains were lost by inapparent typhus infection after one to six transfers. Of these Nos. 3, 7, and 28 showed one or two scrotal reactions, but the majority of the inoculated animals showed no swelling. The remaining 10 strains were characterized by the Europeanlike course of the infection. However, the scrotal reaction was not infrequent and in many cases lasted as long as in murine strains, which may be accounted for by the considerable doses of inoculum injected, reaching at times one half of a brain into one single guinea pig. In these Europeanlike strains the microscopic examination of the tunica when the scrotal swelling appeared very rarely showed rickettsia bodies.

Strains No. 42, 44, and 45 were transferred from 11 to more than 25 generations, many of the animals showing the scrotal reaction; but this was not easily transferred from tunica material, and with the exception of No. 42, in which three successive swellings were observed, this sign was never produced consecutively. Furthermore, in one instance, X-rayed rats were inoculated with strain 42 and rickettsiae were found in the tunica of such animals, but the inoculation into guinea pigs of the rat tunica washings failed to produce the scrotal swelling.

TABLE 2.—Varieties of Mexican typhus strains

| Serial number of strain | Date of admission of the patient | Course of the disease | Day of rat inoculation | Transfers into guinea pigs | Guinea pigs inoculated | Guinea pigs with scrotal reaction and fever | Guinea pigs with fever only | Type of the strain | Observations |
|-------------------------|----------------------------------|-----------------------|------------------------|----------------------------|------------------------|---|-----------------------------|--------------------|---|
| 2 | Oct. 27, 1936 | Grave | 8th | 112 | 250 | 250 | 0 | Murine..... | "L" strain used for the preparation of vaccine. |
| 3 | Nov. 13, 1936 | Fatal | 8th | 3 | 4 | 3 | 1 | Intermediate.. | Slight unilateral scrotal reaction. Discontinued. |
| 4 | Dec. 6, 1936 | do. | 11th | 5 | 6 | 1 | 4 | European..... | Last transfer was inapparent. |
| 5 | Jan. 2, 1937 | do. | 10th | 13 | 13 | 11 | 2 | Murine..... | Discontinued. |
| 7 | Feb. 8, 1937 | Mild | 10th | 6 | 6 | 2 | 3 | Intermediate.. | Last transfer was inapparent. |
| 11 | Mar. 28, 1937 | do. | 10th | 6 | 6 | 0 | 5 | European..... | Do. |
| 13 | June 28, 1937 | do. | 8th | 3 | 3 | 1 | 1 | (?)..... | Do. |
| 22 | Aug. 18, 1937 | Grave | 10th | 7 | 7 | 1 | 6 | European..... | Lost accidentally. ¹ |
| 24 | Aug. 25, 1937 | do. | 11th | 6 | 6 | 0 | 6 | do..... | Do. ¹ |
| 25 | Aug. 31, 1937 | Mild ¹ | 9th | 7 | 7 | 0 | 7 | do..... | Do. ¹ |
| 26 | do. | do. ¹ | 4th | 8 | 8 | 0 | 8 | do..... | Lost by intercurrent infection. |
| 27 | do. | do. ¹ | 9th | 11 | 11 | 1 | 10 | do..... | Do. |
| 28 | Sept. 5, 1937 | do. | 7th | 5 | 5 | 1 | 4 | (?)..... | Lost accidentally. ¹ |
| 31 | Sept. 28, 1937 | do. | 7th | 2 | 2 | 0 | 1 | (?)..... | Last transfer was inapparent. |
| 32 | Oct. 9, 1937 | Fatal | 8th | 1 | 1 | 0 | 0 | (?)..... | Inapparent infection proved by immunity test. |
| 39 | Dec. 3, 1937 | Mild | 8th | 1 | 1 | 0 | 0 | (?)..... | Do. |
| 42 | Jan. 11, 1938 | do. | 12th | 27 | 53 | 10 | 43 | European..... | Nonorehittic strain No. 42. |
| 44 | Jan. 20, 1938 | do. | 9th | 17 | 18 | 4 | 14 | do..... | Discontinued. |
| 45 | Jan. 21, 1938 | do. | 9th | 11 | 12 | 2 | 10 | do..... | Do. |
| 46 | Jan. 24, 1938 | Fatal | 9th | 2 | 2 | 0 | 1 | (?)..... | Last transfer was inapparent. |

¹ An accident occurred in the animal room which resulted in the loss of several guinea pigs, including those inoculated with strains 22, 24, 25, and 28.

² These patients were members of the same family.

BRAIN LESIONS

A search for brain lesions in guinea pigs infected with both orchitic and nonorchitic strains showed that the orchitic strain "L" had little tendency to produce typhus lesions in the brain as compared with nonorchitic strains. The animals were killed on the seventh, eleventh, and sixteenth days, and the lesions were usually found on the eleventh day. Eight nonorchitic strains studied showed brain lesions when the animals were killed on the eleventh to the sixteenth day. The lesions were particularly numerous in strain 42, which we have kept as representative of the Mexican nonorchitic strains.

A systematic study of the brain lesions is now being conducted in a manner similar to that followed by Lillie, Dyer, and Armstrong (8).

TRANSFER OF MEXICAN NONORCHITIC STRAINS THROUGH MICE

Since Nicolle and Laigret (9) and Laigret and Jadin (10) found that Old World typhus was lost by successive transfers in rats and mice, while murine strains were easily kept in these animal species, we found it interesting to test our nonorchitic strains in mice. Strains No. 27, 42, 44, and 45 were inoculated into mice and transferred from mice to mice for three or four generations. The guinea pigs that were injected in order to detect the presence of typhus infection showed that these strains were lost from the second to the third transfer from mice to mice. These experiments show that there is an additional similarity between our nonorchitic strains and the Old World typhus.

VACCINATION EXPERIMENTS AGAINST MEXICAN ORCHITIC AND NON-ORCHITIC STRAINS

One of our orchitic strains has been used for the preparation of vaccines by methods recommended by Zinsser and Castaneda (11). The vaccines contained about 5,000 million rickettsiae per cubic centimeter and have been tested in guinea pigs subsequently inoculated with the homologous strain. This vaccine has been used in this laboratory in 14 workers who have been in close contact with typhus strains. Of these workers one developed a short febrile reaction 1 month after vaccination which, because of the characteristic serologic reaction (12), we suspect was an accidental typhus infection.

Recently, a careful study of the vaccine was made in our laboratories by Veintemillas (13), who demonstrated that the Mexican vaccine was capable of protecting guinea pigs with a single dose of 1 cc. of formalized rickettsiae given subcutaneously. Partial protection was obtained by injection of $\frac{1}{2}$, $\frac{1}{4}$, and even $\frac{1}{8}$ cc. The vaccinated animals were tested with the "L" strain used for the preparation of the vaccine. In the same series of experiments Veintemillas observed that guinea

pigs vaccinated with one single dose of vaccine and tested with the nonorchitic strain No. 42 developed typical Europeanlike typhus, exactly as did the nonvaccinated controls. This failure to protect

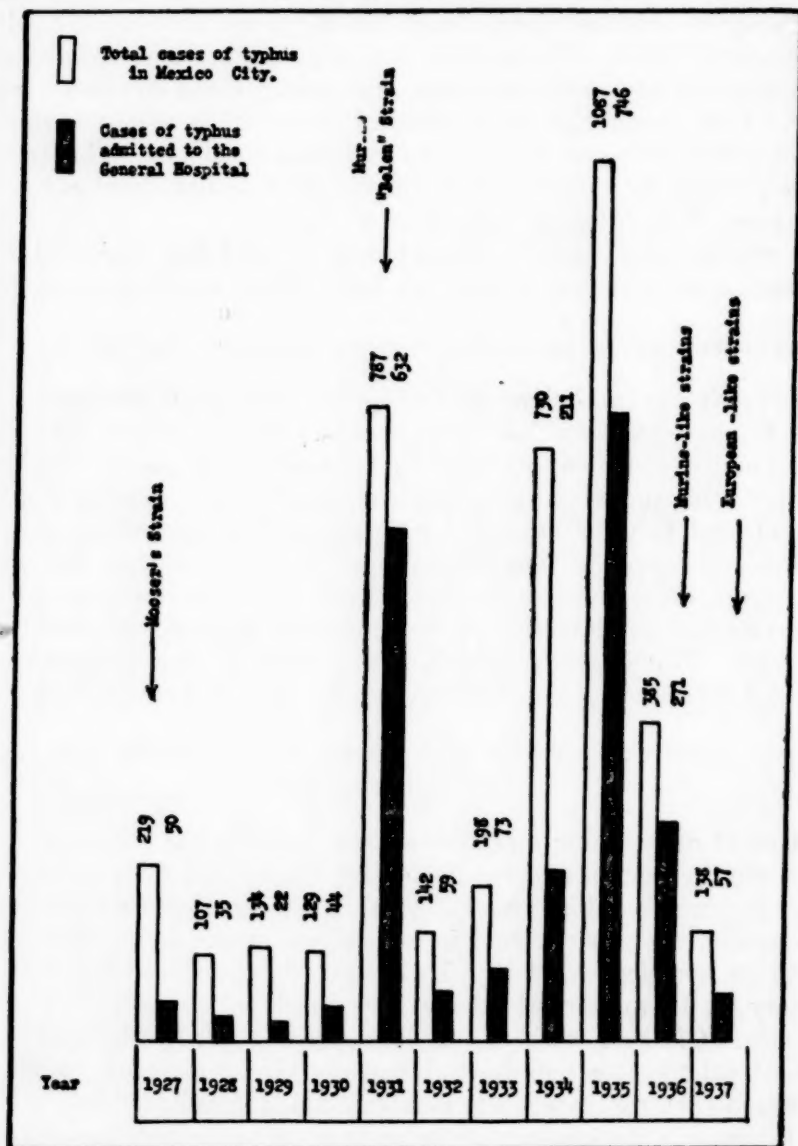


FIGURE 1.

guinea pigs with Mexican vaccine against Mexican nonorchitic strains with doses which were effective against the homologous "L" murine-like typhus shows another property which belongs to the European strains. However, the treatment of guinea pigs with three or four doses of vaccine at 5-day intervals afforded complete protection against strain No. 42.

DISCUSSION

The incidence of typhus fever in the city of Mexico during the 16 months of observation to which we have referred in this paper, was lower than in comparative periods of time in previous years. The number of cases admitted to the General Hospital at an average of 4.5 per month, with a maximum of 9 and a minimum of 1, gives a fair idea of the total monthly incidence in this city. Figure 1 shows the incidence of typhus registered from 1927 to 1937 in Mexico City and suburbs, and in black columns are recorded those admitted to the Hospital. Whether the cases registered from October 1936 to January 1938 may be considered endemic or as a long standing epidemic of low case rate, we are not in a position to discuss, but it is evident that the typical outburst of an epidemic of typhus did not occur within this period of time. The isolation of various strains of typhus which presented great differences from one another corroborates the hypothesis that typhus fever in Mexico is constantly starting from a murine origin and then, by the influence of man-to-man adaptation, undergoes transformation towards the European type. Many strains may revert to the original murine type, but others retain the newly acquired characteristics. This theory, which has been repeatedly sustained by Zinsser, Mooser, Nicolle, and ourselves, is illustrated in table 3. Some of the known strains of typhus are indicated with their relative positions between the murine and European types.

TABLE 3

| Strain | Neil-Mooser reaction | Type of the strain |
|---|--|--------------------------|
| Brelnl strain | Incidental | Typical European typhus. |
| Tunisian typhus | do. | European. |
| "Boston" (Zinsser and Castaneda, 1933). | Not observed | Do. |
| Strains No. 42, 44, and 45 | Frequent | Do. |
| "Zinacatepec" (Mooser, Varela, and Pils, 1934). | Reverted to orchitic typhus ¹ | Intermediates. |
| "J" strain (Castaneda, 1930) | do. ² | Do. |
| No. 7 | Spontaneously reverted | Do. |
| "L" strain | Constant | Murine. |
| American sporadic strains (Maxcy, 1929). | do. | Do. |
| Mooser strain (1928) | do. | Do. |
| Dyer's flea strains (1931) | do. | Do. |
| "Belen" strains (Mooser, Castaneda, and Zinsser, 1931). | do. | Typical murine typhus. |

¹ The infected animals were inoculated daily in the peritoneum with guinea pig blood.

² The strain was transferred through human lice and then recovered in guinea pigs.

One of the most important differences between European and Mexican typhus was that found by Zinsser and Castaneda (14) in their cross-immunization experiments. The observation in our laboratory, by Veintemillas (13), of similar differences in the protective power of the vaccine against orchitic and nonorchitic Mexican strains is a valuable contribution, because it suggests that the immunological differences are only quantitative. We believe, so far, that it is

premature to consider that the Mexican vaccine is insufficient to protect against the European typhus, as such opinions are based mainly on the relatively short experimental data of Zinsser and Castaneda (14). Certain other work in this line cannot be given serious consideration, owing to the low antigenic value of the vaccines with which it was made. The necessity of using rich vaccines is emphasized by the fact, already mentioned, that the vaccine protects better against Mexican orchitic than against Mexican nonorchitic strains, unless we assume that No. 42 is an imported strain.

In regard to the subdivision of Mexican typhus into "endemic" and "epidemic" based on the clinical aspects of the guinea-pig infection, we believe that such designations are not correct. Typical murine-like strains have been found during epidemic periods, and on the other hand our Europeanlike strains were isolated during a non-epidemic period.

SUMMARY

From October 1936 to January 1938, 69 cases of typhus were admitted to the General Hospital of Mexico City. Of these cases, 46 were bled for inoculation into rats and then guinea pigs were inoculated with the brains of those rats which survived 15 to 30 days after injection. Eight rats died from intercurrent infection before they were ready for transfer, but the 38 remaining animals produced in guinea pigs 20 typhus strains. Two of these strains showed the characteristics of the murine typhus; 8 were lost by inapparent infection, but some showed the scrotal reaction after one or more transfers into guinea pigs; and the remaining 10 strains were nonorchitic, showed numerous brain lesions, could not be kept in mice for more than two transfers and had some minor immunological differences from the orchitic strains. These properties correspond to the European type of typhus, but it is our opinion that such strains were not imported.

REFERENCES

- (1) Castaneda, M. Ruiz: A study of the relationship of the scrotal swelling and rickettsia bodies to Mexican typhus fever. *J. Exp. Med.*, **52**: 195 (1930).
- (2) Mooser, H.: Experiments relating to pathology and etiology of Mexican typhus (tabardillo), clinical course and pathologic anatomy of tabardillo in guinea pigs. *J. Infect. Dis.*, **43**: 241 (1928).
- (3) Dyer, R. E., Rumreich, A., and Badger, L. F.: Typhus fever; virus of typhus type derived from fleas collected from wild rats. *Pub. Health Rep.*, **46**: 334 (1931).
- (4) Mooser, H., Castaneda, M. Ruiz, and Zinsser, H.: Rats as carriers of Mexican typhus fever. *J. Am. Med. Assoc.*, **97**: 231 (1931).
- (5) Nicolle, C.: Origine commune des typhus et des autres fièvres exanthématiques. Leur individualité présente. *Arch. Inst. Pasteur de Tunis*, **21**: 32 (1932).
- (6) Mooser, H., Varela, G., and Pils, H.: Experiments on conversion of typhus strains. *J. Exp. Med.*, **59**: 137 (1934).
- (7) Savor, S. R., and Velasco, R.: Survival of varieties of typhus virus in mouse passage, with particular reference to virus of Brill's disease. *J. Exp. Med.*, **60**: 317 (1934).

- (8) Lillie, R. D., Dyer, R. E., Armstrong, C., and Pasternack, J. G.: Seasonal variation in intensity of brain reaction of St. Louis encephalitis in mice and of endemic typhus in guinea pigs. *Pub. Health Rep.*, **52**: 1805 (1937).
- (9) Nicolle, C., and Laigret, J.: Entretien du virus typhique historique (souche tunisienne) par passage sur rats. *Arch. Inst. Pasteur de Tunis*, **21**: 349 (1933).
- (10) Laigret, J., and Jadin, J.: Sensibilité de la souris blanche aux virus typhiques; passages; conservation du virus dans le cerveau des souris. *Arch. Inst. Pasteur de Tunis*, **21**: 381 (1933).
- (11) Zinsser, H., and Castaneda, M. Ruiz: Method of obtaining large amounts of *Rickettsia provanceki* by X-ray radiation of rats. *Proc. Soc. Exp. Biol. and Med.*, **29**: 840 (1932).
- (12) Silva Goytia, R.: Un caso de tifo exantematico en individuo vacunado. *Medicina, Mexico*, **18**: 127 (1938).
- (13) Veintemillas, F.: Vaccination against typhus fever with the Zinsser-Castaneda vaccine. *J. Immunol.*, **36**: 339 (1939).
- (14) Zinsser, H., and Castaneda, M. Ruiz: Studies on typhus fever; active immunization against typhus fever with formalinized virus. *J. Exp. Med.*, **53**: 325 (1931).

ORNITHODOROS PARKERI: DISTRIBUTION AND HOST DATA; SPONTANEOUS INFECTION WITH RELAPSING FEVER SPIROCHETES¹

By GORDON E. DAVIS, *Bacteriologist, Rocky Mountain Laboratory, United States Public Health Service*

During the past 5 years, the argasid tick, *Ornithodoros parkeri*, described by Cooley (1) in 1936, has been collected in Wyoming, Montana, Utah, Washington, and Colorado. Specimens from three collection areas have been found spontaneously infected with relapsing fever spirochetes. It is the only known likely tick vector of this disease in the first four of these States and in the part of Colorado from which it has been collected, but it has not thus far been positively identified with human infection.

DISTRIBUTION AND HOST DATA

All known distribution and host data of this tick are given in table 1. The determinations were made by Entomologist R. A. Cooley of the Rocky Mountain Laboratory.

These data, for the most part, represent chance observations incident to field work on other problems, a fact which suggests that this tick may be much more generally distributed in the regions indicated.

Since rodent burrows appear to be the usual habitat of this tick, and since it engorges rapidly like most other species of its genus, the finding of even a few specimens on rodents may be indicative of a considerable burrow infestation locally. This has proved true wherever the finding of *parkeri* infested rodents has been followed up by an extensive examination of rodent burrows, as in the Poison Spider Creek collection area in Natrona County, Wyo., and in the area 10 miles northeast of Dillon in Beaverhead County, Mont.

¹ Contribution from the Division of Infectious Diseases, National Institute of Health, Rocky Mountain Laboratory, Hamilton, Mont.

TABLE 1.—*Host, source, and locality data of collections of Ornithodoros parkeri*

| Accession No. | State | Locality | Date | Host animal or source | Ticks collected |
|---------------|------------|--|--------------------|--|--------------------------------|
| 10711 | Wyoming | { Poison Spider Creek 40 miles southwest of Casper, Natrona County. ¹ | { June 7-23, 1934. | <i>Citellus</i> sp. | 1 nymph. |
| 10716 | | | | do. | Do. |
| 10718 | | | | <i>Lepus</i> sp. | Do. |
| 10719 | | | | <i>Cynomys</i> sp. | 3 nymphs. |
| 10722 | do. | do. ¹ | July 27-29, 1935. | <i>Citellus</i> sp. | 1 nymph. |
| 11254 | | | | Burrow of <i>Citellus</i> sp. | 44 nymphs and adults. |
| 11259 | | | | do. | 16 larvae, nymphs, and adults. |
| 11260 | | | | Burrow and nest of <i>Citellus</i> sp. | 44 nymphs and adults. |
| 11284 | do. | 30 miles north of Rock Springs, Sweetwater County. ¹ | Aug. 5, 1936. | <i>Citellus</i> sp. | 1 nymph. |
| 13756 | do. | { 18 miles north of Rock Springs, Sweetwater County. ¹ | { Aug. 6, 1937. | Burrow of <i>Citellus</i> sp. | 13 nymphs, 1 adult. |
| 13757 | | | | do. | 3 nymphs. |
| 13759 | | | | do. | 4 nymphs. |
| 14940 | | | | <i>Citellus</i> sp. | 1 larva, 1 nymph. |
| 14112 | do. | { North of Rawlins, Carbon County. ¹ | { July 12, 1938. | Burrow of <i>Citellus</i> sp. | 16 nymphs, 2 adults. |
| 14113 | | | | From sand under sage brush near burrow of 14112. | 2 nymphs. |
| 14139 | | | | Burrow of <i>Citellus</i> sp. | 1 adult. |
| 14140 | | | | do. | 1 nymph. |
| 14141 | do. | { 16 miles north of Rock Springs, Sweetwater County. ¹ | { July 23, 1938. | do. | 3 adults. |
| 14142 | | | | do. | 1 nymph. |
| 14143 | | | | do. | 1 adult. |
| 13791 | | | | <i>Neotoma</i> sp. | 11 larvae. |
| 13816 | do. | { 11 miles south of Rock Springs, Sweetwater County. ¹ | { do. | Burrow of <i>Citellus</i> sp. | 2 nymphs. |
| 13817 | | | | do. | 9 nymphs, 1 adult. |
| 13812 | | | | do. | 1 nymph. |
| 13813 | | | | do. | 6 larvae. |
| 15240 | do. | Sweetwater County. ¹ | Aug. 24, 1938. | <i>Cynomys leucurus</i> | 1 larva, 2 nymphs. |
| 12302A | Utah | { Wayne County. ¹ | { Aug. 12, 1936. | <i>Citellus</i> sp. | 6 specimens. |
| 12302A | | | | do. | 14 specimens. |
| 15407 | | | | do. | 3 specimens. |
| 10143 | | | | do. | 38 specimens. |
| 15341 | Washington | { Near Yakima, Yakima County | { Aug. 3, 1938. | <i>Cynomys leucurus</i> | 11 specimens. |
| 15341 | | | | <i>Spermophilus</i> sp. | 44 specimens. |
| 12601 | | | | 5 <i>Cynomys leucurus</i> | 6 specimens. |
| 12602 | | | | <i>Citellus richardsoni</i> | 2 specimens. |
| 12603 | Colorado | { Moffat County. ¹ | { June 16, 1936. | do. | 46 specimens. |
| 12603 | | | | do. | 2 specimens. |
| 12603 | | | | do. | 2 specimens. |
| 12603 | | | | do. | 2 specimens. |
| 12703 | Montana | { 10 miles northeast of Dillon, Beaverhead County. ¹ | { June 22, 1936. | <i>Citellus richardsoni</i> | 7 specimens. |
| 12704 | | | | Burrow of <i>C. richardsoni</i> | 14 specimens. |
| 12705 | | | | Burrow and nest of <i>C. richardsoni</i> | 3 specimens. |
| 12630 | | | | Nest of <i>C. richardsoni</i> | 38 specimens. |
| 12703 | do. | { do. | { Sept. 8, 1936. | do. | 11 specimens. |
| 12704 | | | | do. | 44 specimens. |
| 12705 | | | | Burrow and nest of <i>C. richardsoni</i> | 6 specimens. |
| 12630 | | | | do. | 2 specimens. |
| 12630 | do. | { do. | { July 7, 1936. | 14 <i>C. richardsoni</i> | 46 specimens. |
| 12630 | | | | do. | 2 specimens. |
| 12630 | | | | do. | 2 specimens. |
| 12630 | | | | do. | 2 specimens. |

| | | | | | |
|-------|----|--|---------------|-----------------------|---------------------|
| 12613 | do | 10 miles south of Cameron, Madison County ¹ | June 25, 1936 | <i>C. richardsoni</i> | 1 nymph, 1 adult. |
| 12611 | do | 15 miles south of Cameron, Madison County ¹ | do | <i>Clellus</i> sp. | 3 larvae, 4 adults. |
| 13223 | do | 10 miles south of Dillon, Beaverhead County ² | May 28, 1937 | <i>Peromyscus</i> sp. | 1 larva. |

¹ Collected by Bacteriologist Gordon E. Davis, Rocky Mountain Laboratory.

² Collected by Laboratory Assistant E. W. Malone, Rocky Mountain Laboratory.

³ Collected by Assistant Parasitologist W. L. Jellison, Rocky Mountain Laboratory.

⁴ Collected by Medical Entomologist Cornelius B. Philip, Rocky Mountain Laboratory.

⁵ Collected by field crew operating under Surgeon C. R. Eskey, in charge of the Plague Laboratory, San Francisco, Calif.

Less extensive follow-ups have also resulted in locating tick-infested burrows. For example, a return trip of 150 miles was made to an area where a ground squirrel infested with an engorged larva and an early nymph had been shot. Twenty ticks were collected. Two were found in the sand under a sagebrush not far from a burrow, 16 immature forms were in the burrow near its opening, and a ♀ and ♂ were found at the end of a 16-foot excavation of the burrow through sun-baked prairie clay. In another instance a number of rodents had been taken during a 75-mile across-country drive. Late in the day they were examined for parasites. A weasel yielded 11 partially engorged larvae. On a return trip to the location where the weasel was shot, 13 late nymphs and adults were recovered from 3 ground-squirrel burrows.

Experience suggests that the simplest way of determining the local presence or absence of this tick in a given locality is by the examination (screening may be necessary) of earth pulled out of animal burrows by means of a scraper attached to the end of a rod several feet long.

As shown in table 1, this species has been found feeding on ground squirrels, a jack rabbit, a cottontail rabbit, prairie dogs, a weasel, and a white-footed mouse. This suggests that it is by no means highly selective in its choice of hosts.

In the laboratory it feeds readily on white mice, white rats, guinea pigs, monkeys, and man. The following four feeding experiments on man are recorded.

FEEDING OF *O. PARKERI* ON HUMAN VOLUNTEER

On July 8, 1938, male No. 65 was allowed to engorge on the forearm of a human volunteer. It attached readily, engorged completely, and at end of 14 minutes detached voluntarily. No sensation was felt by the volunteer. The following morning there was a red area 4 mm. in diameter at the site of attachment. There was no itching.

On July 11, 1938, male No. 32 was allowed to engorge on the forearm of the volunteer. It attached readily, engorged completely, and at end of 12 minutes detached voluntarily. No sensation nor itching was felt. A deep red area about 3 mm. in diameter occurred in 1 hour, which enlarged to 5 mm. in 6 hours.

Male No. 31 was allowed to engorge on the forearm. It attached readily, engorged completely, and at end of 15 minutes detached voluntarily. There was no sensation. In 6 hours, a deep red area 3 mm. in diameter appeared.

On July 15 all of the above areas were still red and indurated, considerably elevated, and crateriform with necrotic centers. There was some itching. Healing was gradual.

On Sept. 12, 1938, a second stage nymph, No. 39, was placed on the back of the hand where it attached at once. It engorged com-

pletely in 23 minutes and detached voluntarily. There was no sensation. A hemorrhagic area 2 mm. in diameter was present.

On Sept. 13 there was intense itching during night. On Sept. 23 a small scab was removed.

SPONTANEOUS INFECTIONS WITH SPIROCHETES

Six strains of spirochetes have been recovered from ticks representing three of the collection areas, four from the northern part and one from the southern part of Sweetwater County, Wyo., and one from Beaverhead County, Mont. The ticks from Natrona County, Wyo., the one specimen from Washington, and those from Utah and Colorado were received in alcohol and could not be tested.

These strains are easily maintained in white mice and white rats. In the latter, one strain was carried through 180 transfers. In guinea pigs they produce clinical relapses at which times spirochetes are present in the peripheral blood. Thus far they have not produced febrile periods in rhesus monkeys.

POSSIBLE RELATIONSHIP OF *O. PARKERI* SPIROCHETES TO HUMAN INFECTION

Of the several States in which *O. parkeri* occurs, no case of relapsing fever has been reported from Wyoming and none from the part of Colorado in which *parkeri* was collected. A case occurring near Salt Lake City, Utah, in July 1928, was attended by Dr. H. G. MacNeil, then of that city. Tollefsen (3) has reported two cases treated at the Veterans' Facility Administration, Walla Walla, Wash. No satisfactory data have been obtained concerning their points of origin. One apparently was infected at some point in Montana in the early summer of 1927, the other somewhere in Washington in the early fall of 1932.

Since *O. parkeri* is the only known likely transmitting agent of relapsing fever in these two States and since it has been shown that this tick is spontaneously infected with spirochetes which produce a relapsing fever in guinea pigs, it is at least open to suspicion as a transmitting agent to man.

REFERENCES

- (1) Cooley, R. A.: *Ornithodoros parkeri*, a new species on rodents. Pub. Health Rep., 51: 431-433 (1936).
- (2) Parker, R. R., Philip, Cornelius B., Davis, Gordon E., and Cooley, R. A.: J. Econ. Ent., 30: 51 (1937).
- (3) Tollefsen, A. D.: Relapsing fever. Med. Bul. Vet. Admin., 12: 84-85 (July 1935).
- (4) Annual reports of the Surgeon General, U. S. Public Health Service, for 1936, 1937, and 1938.

DEATHS DURING WEEK ENDED JULY 1, 1939

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

| | Week ended July 1, 1939 | Correspond- ing week, 1938 |
|---|----------------------------|----------------------------------|
| Data from 88 large cities of the United States: | | |
| Total deaths..... | 7,369 | 7,580 |
| Average for 3 prior years..... | 17,515 | |
| Total deaths, first 26 weeks of year..... | 229,356 | 221,808 |
| Deaths under 1 year of age..... | 519 | 519 |
| Average for 3 prior years..... | 1,512 | |
| Deaths under 1 year of age, first 26 weeks of year..... | 13,571 | 13,811 |
| Data from industrial insurance companies: | | |
| Policies in force..... | 67,166,768 | 69,248,240 |
| Number of death claims..... | 11,326 | 11,389 |
| Death claims per 1,000 policies in force, annual rate..... | 8.8 | 8.6 |
| Death claims per 1,000 policies, first 26 weeks of year, annual rate..... | 11.1 | 9.7 |

¹ Data for 86 cities.

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers.

In these and the following tables, a zero (0) indicates a positive report and has the same significance as any other figure, while leaders (....) represent no report, with the implication that cases or deaths may have occurred but were not reported to the State health officer.

Cases of certain diseases reported by telegraph by State health officers for the week ended July 8, 1939, rates per 100,000 population (annual basis), and comparison with corresponding week of 1938 and 5-year median

| Division and State | Diphtheria | | | | Influenza | | | | Measles | | | |
|-------------------------------|--------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|
| | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median |
| NEW ENG. | | | | | | | | | | | | |
| Maine..... | 0 | 0 | 0 | 0 | | | 1 | | 91 | 15 | 13 | 21 |
| New Hampshire..... | 0 | 0 | 0 | 0 | | | | | 91 | 9 | 31 | 31 |
| Vermont..... | 0 | 0 | 0 | 0 | | | | | 1,448 | 108 | 30 | 30 |
| Massachusetts..... | 6 | 5 | 0 | 5 | | | | | 425 | 361 | 232 | 232 |
| Rhode Island..... | 0 | 0 | 1 | 0 | | | | | 420 | 55 | 3 | 20 |
| Connecticut..... | 0 | 0 | 1 | 2 | 3 | 1 | 2 | 1 | 448 | 151 | 20 | 78 |
| MID. ATL. | | | | | | | | | | | | |
| New York..... | 4 | 10 | 21 | 28 | 11 | 11 | 11 | 11 | 295 | 738 | 1,299 | 1,299 |
| New Jersey ¹ | 7 | 6 | 8 | 10 | | | 7 | 2 | 26 | 22 | 207 | 442 |
| Pennsylvania..... | 4 | 7 | 28 | 30 | | | | | 43 | 85 | 630 | 630 |
| E. NO. CEN. | | | | | | | | | | | | |
| Ohio..... | 8 | 11 | 8 | 11 | 4 | 5 | | 2 | 10 | 13 | 246 | 387 |
| Indiana..... | 9 | 6 | 4 | 7 | 6 | 4 | | 7 | 6 | 4 | 131 | 67 |
| Illinois ¹ | 14 | 21 | 25 | 35 | 2 | 3 | 4 | 5 | 14 | 21 | 177 | 326 |
| Michigan ¹ | 1 | 1 | 6 | 7 | | | | | 99 | 94 | 714 | 260 |
| Wisconsin..... | 0 | 0 | 2 | 2 | 14 | 8 | 10 | 10 | 380 | 216 | 855 | 821 |
| W. NO. CEN. | | | | | | | | | | | | |
| Minnesota..... | 4 | 2 | 1 | 1 | 2 | 1 | | | 60 | 31 | 135 | 40 |
| Iowa ¹ | 8 | 4 | 0 | 2 | | | | | 205 | 101 | 122 | 13 |
| Missouri..... | 4 | 3 | 14 | 14 | | | 6 | 11 | 5 | | 36 | 36 |
| North Dakota..... | 0 | 0 | 1 | 1 | 58 | 8 | 1 | | 110 | 15 | 41 | 1 |
| South Dakota..... | 8 | 1 | 1 | 2 | | | | | 225 | 30 | 0 | 5 |
| Nebraska..... | 0 | 0 | 1 | 2 | | | | | 23 | 6 | 29 | 14 |
| Kansas..... | 0 | 0 | 3 | 5 | | | | | 34 | 12 | 31 | 31 |

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended July 8, 1939, rates per 100,000 population (annual basis), and comparison with corresponding week of 1938 and 5-year median—Continued

| Division and State | Diphtheria | | | | Influenza | | | | Measles | | | |
|-------------------------------------|--------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|
| | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median |
| SO. ATL. | | | | | | | | | | | | |
| Delaware..... | 0 | 0 | 1 | 1 | | | | | 79 | 4 | 2 | 5 |
| Maryland ^{1 2 3 4} | 12 | 4 | 1 | 3 | 9 | 3 | 1 | 1 | 52 | 17 | 44 | 44 |
| Dist. of Col..... | 0 | 0 | 2 | 3 | | | | | 386 | 47 | 12 | 20 |
| Virginia ^{1 4} | 19 | 10 | 26 | 6 | 36 | 19 | | | 240 | 128 | 151 | 89 |
| West Virginia..... | 8 | 3 | 4 | 4 | 3 | 1 | 11 | 5 | 11 | 4 | 49 | 49 |
| North Carolina ^{1 4} | 4 | 3 | 5 | 6 | 1 | 1 | 6 | | 54 | 37 | 337 | 127 |
| South Carolina ⁴ | 11 | 4 | 10 | 1 | 303 | 111 | 90 | 53 | 19 | 7 | 100 | 18 |
| Georgia ⁴ | 18 | 11 | 9 | 3 | 7 | 4 | | | 17 | 10 | 0 | |
| Florida ⁴ | 0 | 0 | 5 | 5 | 9 | 3 | | | 39 | 13 | 10 | 9 |
| E. SO. CEN. | | | | | | | | | | | | |
| Kentucky..... | 5 | 3 | 2 | 4 | 10 | 6 | 3 | 3 | 7 | 4 | 45 | 53 |
| Tennessee..... | 7 | 4 | 7 | 5 | 12 | 7 | 8 | 8 | 72 | 41 | 46 | 35 |
| Alabama ⁴ | 16 | 9 | 9 | 9 | 7 | 4 | 10 | 3 | 69 | 39 | 42 | 25 |
| Mississippi ^{1 4} | 15 | 6 | 3 | 4 | | | | | | | | |
| W. SO. CEN. | | | | | | | | | | | | |
| Arkansas..... | 7 | 3 | 4 | 3 | 15 | 6 | 10 | 3 | 25 | 10 | 45 | 5 |
| Louisiana ⁴ | 15 | 6 | 11 | 11 | 24 | 10 | 9 | 9 | 27 | 11 | 4 | 5 |
| Oklahoma..... | 2 | 1 | 4 | 4 | 8 | 4 | 27 | 12 | 16 | 8 | 17 | 17 |
| Texas ⁴ | 12 | 14 | 13 | 17 | 28 | 34 | 90 | 60 | 82 | 99 | 40 | 86 |
| MOUNTAIN | | | | | | | | | | | | |
| Montana..... | 0 | 0 | 0 | 0 | 19 | 2 | | | 421 | 45 | 0 | 8 |
| Idaho ¹ | 0 | 0 | 1 | 0 | | | | | 71 | 7 | 1 | 3 |
| Wyoming ¹ | 0 | 0 | 1 | 1 | | | | | 393 | 18 | 3 | 3 |
| Colorado ^{1 4} | 39 | 8 | 12 | 3 | 48 | 10 | | | 67 | 14 | 55 | 59 |
| New Mexico..... | 0 | 0 | 2 | 2 | | | | | 124 | 10 | 5 | 13 |
| Arizona..... | 25 | 2 | 0 | 1 | 331 | 27 | 11 | 6 | 25 | 2 | 17 | 15 |
| Utah ^{1 4} | 20 | 2 | 7 | 0 | 10 | 1 | | | 457 | 46 | 97 | 36 |
| PACIFIC | | | | | | | | | | | | |
| Washington..... | 9 | 3 | 0 | 1 | | | | | 1,600 | 519 | 11 | 69 |
| Oregon..... | 10 | 2 | 1 | 1 | 15 | 3 | 7 | 6 | 169 | 34 | 14 | 14 |
| California..... | 18 | 22 | 27 | 24 | 7 | 9 | 11 | 14 | 394 | 481 | 394 | 394 |
| Total..... | 8 | 197 | 292 | 292 | 14 | 296 | 326 | 275 | 151 | 3,746 | 6,523 | 6,523 |
| 27 weeks..... | 15 | 10,424 | 12,479 | 13,385 | 262 | 149,771 | 44,016 | 102,548 | 506 | 338,261 | 745,983 | 651,646 |

| Division and State | Meningitis, meningococcus | | | | Polliomycelitis | | | | Scarlet fever | | | |
|-------------------------------|---------------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|
| | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median |
| NEW ENG. | | | | | | | | | | | | |
| Maine..... | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 24 | 4 | 8 | 8 |
| New Hampshire..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 1 | 2 | 2 |
| Vermont..... | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 13 | 1 | 6 | 2 |
| Massachusetts..... | 2.4 | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 51 | 43 | 95 | 74 |
| Rhode Island..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 | 6 | 6 | 6 |
| Connecticut..... | 3 | 1 | 0 | 0 | 3 | 1 | 0 | 0 | 36 | 12 | 23 | 23 |
| MID. ATL. | | | | | | | | | | | | |
| New York..... | 1.6 | 4 | 2 | 11 | 1.6 | 4 | 1 | 6 | 43 | 108 | 141 | 212 |
| New Jersey ¹ | 0 | 0 | 0 | 1 | 1.2 | 1 | 0 | 1 | 61 | 51 | 31 | 41 |
| Pennsylvania..... | 2.5 | 5 | 2 | 4 | 0 | 0 | 0 | 0 | 65 | 128 | 122 | 177 |

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended July 8, 1939, rates per 100,000 population (annual basis), and comparison with corresponding week of 1938 and 5-year median—Continued

| Division and State | Meningitis, meningo-coccus | | | | Poliomyelitis | | | | Scarlet fever | | | |
|-------------------------------------|----------------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|-----------------|
| | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median |
| E. NO. CEN. | | | | | | | | | | | | |
| Ohio..... | 0.8 | 1 | 2 | 2 | 0 | 0 | 1 | 1 | 31 | 40 | 89 | 100 |
| Indiana..... | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 18 | 12 | 30 | 28 |
| Illinois ² | 0 | 0 | 1 | 5 | 0 | 0 | 2 | 2 | 51 | 78 | 133 | 100 |
| Michigan ³ | 1.1 | 1 | 1 | 1 | 4 | 4 | 0 | 0 | 94 | 89 | 135 | 135 |
| Wisconsin..... | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 100 | 57 | 46 | 87 |
| W. NO. CEN. | | | | | | | | | | | | |
| Minnesota..... | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 29 | 15 | 25 | 39 |
| Iowa ² | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 32 | 16 | 18 | 23 |
| Missouri..... | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 10 | 8 | 30 | 25 |
| North Dakota..... | 7 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 15 | 2 | 5 | 5 |
| South Dakota..... | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 46 | 6 | 3 | 9 |
| Nebraska..... | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 15 | 4 | 5 | 9 |
| Kansas..... | 2.8 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 61 | 22 | 25 | 25 |
| SO. ATL. | | | | | | | | | | | | |
| Delaware..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 2 | 2 | 2 |
| Maryland ^{2 3 4} | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 5 | 12 | 15 |
| Dist. of Col..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 3 | 5 | 7 |
| Virginia ^{2 4} | 4 | 2 | 1 | 3 | 1.9 | 1 | 0 | 1 | 21 | 11 | 11 | 11 |
| West Virginia..... | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 38 | 14 | 10 | 18 |
| North Carolina ^{2 4} | 2.9 | 2 | 1 | 2 | 9 | 6 | 1 | 1 | 19 | 13 | 17 | 15 |
| South Carolina ⁴ | 5 | 2 | 1 | 1 | 55 | 20 | 0 | 0 | 0 | 0 | 6 | 2 |
| Georgia ⁴ | 1.7 | 1 | 0 | 0 | 17 | 10 | 1 | 1 | 7 | 4 | 8 | 4 |
| Florida ⁴ | 3 | 1 | 1 | 1 | 12 | 4 | 0 | 0 | 3 | 1 | 1 | 1 |
| E. SO. CEN. | | | | | | | | | | | | |
| Kentucky..... | 5 | 3 | 1 | 2 | 1.7 | 1 | 1 | 1 | 12 | 7 | 12 | 14 |
| Tennessee..... | 0 | 0 | 3 | 3 | 4 | 2 | 0 | 1 | 26 | 15 | 13 | 11 |
| Alabama ⁴ | 0 | 0 | 5 | 1 | 4 | 2 | 5 | 4 | 16 | 9 | 11 | 7 |
| Mississippi ^{2 4} | 5 | 2 | 0 | 0 | 2.5 | 1 | 3 | 0 | 18 | 7 | 7 | 5 |
| W. SO. CEN. | | | | | | | | | | | | |
| Arkansas..... | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 5 | 2 | 2 | 2 |
| Louisiana ⁴ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 4 | 8 | 4 |
| Oklahoma..... | 0 | 0 | 2 | 1 | 6 | 3 | 1 | 1 | 8 | 4 | 9 | 8 |
| Texas ⁴ | 0 | 0 | 0 | 1 | 3 | 4 | 0 | 2 | 14 | 17 | 41 | 26 |
| MOUNTAIN | | | | | | | | | | | | |
| Montana..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56 | 6 | 0 | 9 |
| Idaho ² | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 1 | 0 | 2 |
| Wyoming ² | 0 | 0 | 0 | 0 | 22 | 1 | 0 | 0 | 0 | 0 | 2 | 7 |
| Colorado ^{2 3} | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 39 | 8 | 18 | 18 |
| New Mexico..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 3 | 9 | 7 |
| Arizona..... | 0 | 0 | 1 | 0 | 12 | 1 | 1 | 1 | 12 | 1 | 4 | 4 |
| Utah ^{2 3} | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 89 | 9 | 10 | 10 |
| PACIFIC | | | | | | | | | | | | |
| Washington..... | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 43 | 14 | 13 | 14 |
| Oregon..... | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 25 | 5 | 11 | 11 |
| California..... | 1.6 | 2 | 0 | 2 | 15 | 18 | 4 | 8 | 43 | 53 | 63 | 79 |
| Total..... | 1.3 | 32 | 28 | 78 | 3 | 84 | 32 | 156 | 37 | 921 | 1,283 | 1,550 |
| 27 weeks..... | 1.8 | 1,205 | 1,926 | 3,708 | 1.3 | 877 | 580 | 1,071 | 165 | 111,719 | 131,647 | 158,823 |

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended July 8, 1939, rates per 100,000 population (annual basis), and comparison with corresponding week of 1938 and 5-year median—Continued

| Division and State | Smallpox | | | | Typhoid and paratyphoid fever | | | | Whooping cough | | |
|-------------------------------------|--------------------|---------------------|---------------------|-----------------|-------------------------------|---------------------|---------------------|-----------------|--------------------|---------------------|---------------------|
| | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases | 1934-38, median | July 8, 1939, rate | July 8, 1939, cases | July 9, 1938, cases |
| NEW ENG. | | | | | | | | | | | |
| Maine..... | 0 | 0 | 0 | 0 | 18 | 3 | 2 | 1 | 24 | 4 | 24 |
| New Hampshire..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 2 | 0 |
| Vermont..... | 0 | 0 | 0 | 0 | 13 | 1 | 0 | 0 | 483 | 36 | 16 |
| Massachusetts..... | 0 | 0 | 0 | 0 | 6 | 5 | 1 | 1 | 82 | 70 | 92 |
| Rhode Island..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 99 | 13 | 30 |
| Connecticut..... | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 113 | 38 | 79 |
| MID. ATL. | | | | | | | | | | | |
| New York..... | 0 | 0 | 0 | 0 | 2 | 4 | 5 | 7 | 165 | 413 | 406 |
| New Jersey ¹ | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 3 | 264 | 222 | 237 |
| Pennsylvania..... | 0 | 0 | 0 | 0 | 2 | 4 | 5 | 13 | 235 | 462 | 211 |
| E. NO. CEN. | | | | | | | | | | | |
| Ohio..... | 10 | 13 | 3 | 1 | 5 | 7 | 13 | 10 | 79 | 103 | 156 |
| Indiana..... | 24 | 16 | 16 | 3 | 7 | 5 | 7 | 7 | 128 | 80 | 15 |
| Illinois ¹ | 1 | 2 | 11 | 4 | 5 | 7 | 13 | 12 | 150 | 229 | 292 |
| Michigan ² | 0 | 0 | 2 | 0 | 1 | 1 | 2 | 5 | 128 | 121 | 300 |
| Wisconsin..... | 2 | 1 | 3 | 9 | 0 | 0 | 2 | 2 | 450 | 256 | 185 |
| W. NO. CEN. | | | | | | | | | | | |
| Minnesota..... | 10 | 5 | 5 | 5 | 0 | 0 | 1 | 2 | 41 | 21 | 30 |
| Iowa ¹ | 41 | 20 | 16 | 10 | 6 | 3 | 0 | 1 | 55 | 27 | 11 |
| Missouri..... | 12 | 9 | 10 | 4 | 5 | 4 | 17 | 14 | 22 | 17 | 58 |
| North Dakota..... | 0 | 0 | 13 | 3 | 15 | 2 | 0 | 0 | 110 | 15 | 13 |
| South Dakota..... | 53 | 7 | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| Nebraska..... | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0 | 76 | 20 | 3 |
| Kansas..... | 0 | 0 | 0 | 0 | 3 | 1 | 4 | 5 | 53 | 19 | 123 |
| SO. ATL. | | | | | | | | | | | |
| Delaware..... | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 138 | 7 | 7 |
| Maryland ^{2,3,4} | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 126 | 41 | 36 |
| Dist. of Col..... | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 234 | 29 | 4 |
| Virginia ^{2,4} | 0 | 0 | 0 | 0 | 66 | 35 | 31 | 16 | 489 | 261 | 242 |
| West Virginia..... | 3 | 1 | 0 | 0 | 24 | 9 | 1 | 8 | 24 | 9 | 64 |
| North Carolina ^{2,4} | 0 | 0 | 1 | 0 | 16 | 11 | 29 | 19 | 164 | 112 | 282 |
| South Carolina ⁴ | 0 | 0 | 0 | 0 | 96 | 35 | 26 | 21 | 246 | 90 | 208 |
| Georgia ⁴ | 2 | 1 | 0 | 0 | 42 | 25 | 44 | 38 | 81 | 49 | 75 |
| Florida ⁴ | 0 | 0 | 0 | 0 | 6 | 2 | 1 | 1 | 18 | 6 | 16 |
| E. SO. CEN. | | | | | | | | | | | |
| Kentucky..... | 0 | 0 | 4 | 2 | 40 | 21 | 28 | 26 | 36 | 21 | 56 |
| Tennessee..... | 0 | 0 | 0 | 0 | 58 | 33 | 29 | 24 | 125 | 71 | 83 |
| Alabama ⁴ | 0 | 0 | 2 | 0 | 11 | 6 | 19 | 19 | 92 | 52 | 39 |
| Mississippi ^{4,5} | 0 | 0 | 0 | 0 | 30 | 12 | 13 | 15 | | | |
| W. SO. CEN. | | | | | | | | | | | |
| Arkansas..... | 0 | 0 | 0 | 0 | 40 | 16 | 17 | 17 | 45 | 18 | 36 |
| Louisiana ⁴ | 0 | 0 | 0 | 0 | 56 | 23 | 15 | 15 | 29 | 12 | 40 |
| Oklahoma..... | 12 | 6 | 3 | 0 | 40 | 20 | 4 | 16 | 6 | 3 | 9 |
| Texas ⁴ | 0 | 0 | 2 | 4 | 36 | 43 | 82 | 61 | 58 | 70 | 261 |
| MOUNTAIN | | | | | | | | | | | |
| Montana..... | 47 | 5 | 33 | 18 | 28 | 3 | 1 | 2 | 47 | 5 | 0 |
| Idaho ² | 61 | 6 | 2 | 2 | 0 | 0 | 1 | 0 | 122 | 12 | 0 |
| Wyoming ² | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 | 3 | 3 |
| Colorado ^{2,3} | 0 | 0 | 0 | 2 | 10 | 2 | 4 | 2 | 246 | 51 | 27 |
| New Mexico..... | 0 | 0 | 2 | 0 | 25 | 2 | 7 | 7 | 161 | 13 | 29 |
| Arizona..... | 0 | 0 | 2 | 0 | 25 | 2 | 3 | 3 | 98 | 8 | 49 |
| Utah ^{2,3} | 0 | 0 | 0 | 0 | 10 | 1 | 2 | 0 | 546 | 55 | 66 |
| PACIFIC | | | | | | | | | | | |
| Washington..... | 6 | 2 | 19 | 11 | 15 | 5 | 0 | 1 | 25 | 8 | 19 |
| Oregon..... | 0 | 0 | 26 | 3 | 5 | 1 | 0 | 2 | 35 | 7 | 41 |
| California..... | 11 | 13 | 10 | 3 | 3 | 4 | 6 | 6 | 70 | 85 | 215 |
| Total | 4 | 107 | 193 | 112 | 14 | 361 | 450 | 450 | 132 | 3,272 | 4,208 |
| 27 weeks | 12 | 8,379 | 12,130 | 5,685 | 6 | 4,164 | 4,748 | 4,748 | 157 | 105,049 | 115,995 |

¹ New York City only.

² Rocky Mountain spotted fever, week ended July 8, 1939, 17 cases as follows: New Jersey, 1; Illinois, 2; Iowa, 1; Maryland, 2; Virginia, 4; North Carolina, 2; Idaho, 1; Wyoming, 1; Colorado, 1; Utah, 2.

³ Period ended earlier than Saturday.

⁴ Typhus fever, week ended July 8, 1939, 50 cases as follows: Maryland, 1; Virginia, 2; North Carolina, 4; South Carolina, 2; Georgia, 12; Florida, 2; Alabama, 9; Mississippi, 1; Louisiana, 5; Texas, 12.

⁵ Colorado tick fever, Colorado, 2 cases.

ROCKY MOUNTAIN SPOTTED FEVER

Cases of Rocky Mountain spotted fever, which were formerly reported from only a limited area in certain Western States, have in recent years been reported in increasing numbers from Eastern and Central States. The average percent of the total number of cases reported in recent years has been about 29 percent in the New England, Middle Atlantic, and South Atlantic States, combined, and about 5 percent in the Central States.

Reports for previous years indicate that, while cases are reported in every month of the year, February is the month of fewest cases, the season of increased prevalence beginning early in March or possibly in February in the Mountain States, and in late April or early May in the Eastern States. The peak appears to be reached in June in the West and in July in the East. Comparatively few cases are reported after July in the Western States, but cases continue to be reported in considerable numbers in the Eastern States until the middle of September, and in decreasing numbers to the end of the year.

The accompanying table shows, for the current year, by 4-week periods, the number of cases of Rocky Mountain spotted fever reported to the Public Health Service by the health officers of the various States, beginning immediately after the seasonal quiescence of the disease. Similar tables will continue to be published throughout the season of prevalence.

Cases reported by States for 4-week periods, February 26 to July 15, 1939

| State | Feb. 26 to Mar. 25 | Mar. 26 to Apr. 22 | Apr. 23 to May 20 | May 21 to June 17 | June 18 to July 15 |
|---------------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|
| New York..... | | | | 3 | 3 |
| New Jersey..... | | | | 4 | 8 |
| Pennsylvania..... | | | | 6 | 8 |
| Ohio..... | | | | 3 | 2 |
| Indiana..... | | | | 2 | 1 |
| Illinois..... | | | 1 | 1 | 6 |
| Iowa..... | | | 1 | 10 | 9 |
| Missouri..... | | | | 1 | |
| Delaware..... | | | | 3 | |
| Maryland..... | | | 7 | 13 | 11 |
| District of Columbia..... | | | 2 | 2 | 2 |
| Virginia..... | | | 1 | 13 | 10 |
| North Carolina..... | | | | 3 | 13 |
| Georgia..... | | | | | 1 |
| Tennessee..... | | | 1 | | 3 |
| Montana..... | 12 | 2 | 8 | 5 | 2 |
| Idaho..... | | 4 | 7 | 4 | 5 |
| Wyoming..... | | 3 | 14 | 16 | 6 |
| Colorado..... | | 2 | 3 | 9 | 4 |
| Utah..... | | 2 | 5 | 5 | 6 |
| Washington..... | | 2 | 3 | 2 | |
| Oregon..... | | 9 | 16 | 7 | 2 |

¹ 1 other case was reported in Montana as occurring in February, exact date not given.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week.

| State | Menin- gitis, menin- gococ- cus | Diph- theria | Influ- enza | Ma- lar- ia | Mea- sles | Pella- gra | Polio- mye- litis | Scarlet fever | Small- pox | Ty- phoid and paraty- phoid fever |
|---------------------|---|-----------------|----------------|-------------------|--------------|---------------|-------------------------|------------------|---------------|--|
| <i>March 1939</i> | | | | | | | | | | |
| New Hampshire..... | 0 | 2 | ----- | ----- | 2 | ----- | 0 | 28 | 0 | 0 |
| North Carolina..... | 8 | 67 | 749 | 12 | 5,189 | 13 | 0 | 204 | 1 | 14 |
| <i>April 1939</i> | | | | | | | | | | |
| New Hampshire..... | 0 | 0 | ----- | ----- | 52 | ----- | 0 | 21 | 0 | ----- |
| <i>May 1939</i> | | | | | | | | | | |
| New Hampshire..... | 0 | 0 | ----- | ----- | 12 | ----- | 0 | 14 | 0 | 0 |
| <i>June 1939</i> | | | | | | | | | | |
| Arkansas..... | 4 | 9 | 87 | 626 | 89 | 101 | 4 | 17 | 15 | 52 |
| Connecticut..... | 1 | 3 | 7 | ----- | 2,205 | ----- | 1 | 114 | 6 | 9 |
| Missouri..... | 0 | 24 | 1 | 2 | 23 | ----- | 0 | 133 | 46 | 18 |

| <i>March 1939</i> | | <i>June 1939</i> | | <i>June 1939—Continued</i> | |
|--------------------------|-------|-----------------------------|-------|----------------------------|-------|
| | Cases | | Cases | | Cases |
| New Hampshire: | | Chickenpox: | | Rocky Mountain spotted fe- | |
| Chickenpox..... | 9 | Arkansas..... | 59 | ver: | |
| Mumps..... | 26 | Connecticut..... | 234 | Missouri..... | 1 |
| Whooping cough..... | 10 | Missouri..... | 79 | Septic sore throat: | |
| North Carolina: | | Conjunctivitis, infectious: | | Arkansas..... | 23 |
| Chickenpox..... | 644 | Connecticut..... | 7 | Connecticut..... | 25 |
| Dysentery (amoebic).... | 1 | Dysentery: | | Missouri..... | 6 |
| German measles..... | 52 | Arkansas (amoebic).... | 80 | Tetanus: | |
| Septic sore throat..... | 9 | Arkansas (bacillary).... | 115 | Arkansas..... | 1 |
| Tularaemia..... | 2 | Connecticut (bacillary).. | 3 | Connecticut..... | 1 |
| Typhus fever..... | 1 | Missouri (bacillary).... | 1 | Missouri..... | 2 |
| Undulant fever..... | 2 | German measles: | | Trachoma: | |
| Vincent's infection..... | 7 | Arkansas..... | 4 | Arkansas..... | 15 |
| Whooping cough..... | 1,393 | Connecticut..... | 9 | Missouri..... | 58 |
| <i>April 1939</i> | | Hookworm disease: | | Trichinosis: | |
| | | Arkansas..... | 1 | Arkansas..... | 1 |
| New Hampshire: | | Missouri..... | 1 | Tularaemia: | |
| Chickenpox..... | 15 | Mumps: | | Arkansas..... | 15 |
| Mumps..... | 28 | Arkansas..... | 66 | Missouri..... | 1 |
| Whooping cough..... | 10 | Connecticut..... | 278 | Undulant fever: | |
| <i>May 1939</i> | | Missouri..... | 196 | Arkansas..... | 11 |
| | | Ophthalmia neonatorum: | | Connecticut..... | 11 |
| New Hampshire: | | Arkansas..... | 1 | Missouri..... | 2 |
| Chickenpox..... | 5 | Missouri..... | 1 | Whooping cough: | |
| Mumps..... | 15 | Puerperal septicemia: | | Arkansas..... | 97 |
| Whooping cough..... | 2 | Arkansas..... | 3 | Connecticut..... | 307 |
| | | Rabies in animals: | | Missouri..... | 76 |
| | | Arkansas..... | 26 | | |

WEEKLY REPORTS FROM CITIES

City reports for week ended July 1, 1939

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

| State and city | Diph- theria cases | Influenza | | Meas- les cases | Pneu- monia deaths | Scar- let fever cases | Small- pox cases | Tuber- culosis deaths | Ty- phoid fever cases | Whoop- ing cough cases | Deaths, all causes |
|---------------------------------------|--------------------------|-----------|--------|-----------------------|--------------------------|--------------------------------|------------------------|-----------------------------|--------------------------------|---------------------------------|--------------------------|
| | | Cases | Deaths | | | | | | | | |
| Data for 90 cities: 5-year average | 128 | 37 | 16 | 2,673 | 358 | 850 | 10 | 377 | 53 | 1,299 | ----- |
| Current week | 79 | 23 | 9 | 1,383 | 236 | 436 | 9 | 330 | 42 | 1,301 | ----- |
| Maine: | | | | | | | | | | | |
| Portland | 0 | ----- | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 24 |
| New Hampshire: | | | | | | | | | | | |
| Concord | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 5 |
| Manchester | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 23 |
| Nashua | 0 | ----- | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Vermont: | | | | | | | | | | | |
| Barre | 0 | ----- | ----- | 7 | ----- | 0 | 0 | ----- | 0 | 0 | ----- |
| Burlington | 0 | ----- | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 |
| Rutland | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Massachusetts: | | | | | | | | | | | |
| Boston | 0 | ----- | 0 | 98 | 11 | 14 | 0 | 8 | 2 | 16 | 186 |
| Fall River | 0 | ----- | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 1 | 24 |
| Springfield | 0 | ----- | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 29 |
| Worcester | 0 | ----- | 0 | 18 | 2 | 1 | 0 | 1 | 0 | 19 | 41 |
| Rhode Island: | | | | | | | | | | | |
| Pawtucket | 0 | ----- | 0 | 5 | 0 | 2 | 0 | 2 | 0 | 0 | ----- |
| Providence | 0 | ----- | 0 | 53 | 2 | 4 | 0 | 1 | 0 | 16 | 61 |
| Connecticut: | | | | | | | | | | | |
| Bridgeport | 0 | ----- | 0 | 7 | 1 | 0 | 0 | 0 | 0 | 1 | 30 |
| Hartford | 1 | ----- | 0 | 6 | 2 | 0 | 0 | 0 | 1 | 10 | 48 |
| New Haven | 0 | ----- | 0 | 67 | 0 | 3 | 0 | 0 | 0 | 12 | 41 |
| New York: | | | | | | | | | | | |
| Buffalo | 0 | ----- | 0 | 35 | 9 | 18 | 0 | 7 | 0 | 15 | 128 |
| New York | 9 | 1 | 2 | 129 | 44 | 52 | 0 | 73 | 5 | 117 | 1,178 |
| Rochester | 0 | ----- | 0 | 42 | 4 | 3 | 0 | 0 | 0 | 2 | 63 |
| Syracuse | 0 | ----- | 0 | 80 | 1 | 0 | 0 | 0 | 0 | 98 | 51 |
| New Jersey: | | | | | | | | | | | |
| Camden | 0 | ----- | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 11 | 20 |
| Newark | 0 | ----- | 0 | 2 | 0 | 13 | 0 | 1 | ----- | 64 | 73 |
| Trenton | 0 | ----- | 0 | 0 | 2 | 6 | 0 | 1 | 0 | 0 | 31 |
| Pennsylvania: | | | | | | | | | | | |
| Philadelphia | 2 | 2 | 2 | 31 | 13 | 18 | 0 | 29 | 1 | 126 | 394 |
| Pittsburgh | 1 | 1 | 1 | 2 | 4 | 8 | 0 | 7 | 1 | 32 | 125 |
| Reading | 0 | ----- | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 20 |
| Scranton | 0 | ----- | ----- | 1 | ----- | 2 | 0 | ----- | 0 | 5 | ----- |
| Ohio: | | | | | | | | | | | |
| Cincinnati | 6 | 1 | ----- | 2 | ----- | 39 | 0 | ----- | 2 | 29 | 110 |
| Cleveland | 0 | 6 | 0 | 3 | 4 | 20 | 0 | 9 | 0 | 54 | 155 |
| Columbus | 0 | 1 | 1 | 8 | 1 | 1 | 0 | 2 | 0 | 5 | 80 |
| Toledo | 0 | ----- | 0 | 20 | 2 | 10 | 4 | 3 | 0 | 42 | 75 |
| Indiana: | | | | | | | | | | | |
| Anderson | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 |
| Fort Wayne | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 0 | 0 | 24 |
| Indianapolis | 1 | 0 | 0 | 3 | 2 | 4 | 0 | 2 | 1 | 48 | 88 |
| Muncie | 0 | ----- | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 8 |
| South Bend | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 11 | 14 |
| Terre Haute | 0 | ----- | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 23 |
| Illinois: | | | | | | | | | | | |
| Alton | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Chicago | 15 | 0 | 0 | 10 | 14 | 56 | 0 | 38 | 2 | 109 | 630 |
| Elgin | 0 | ----- | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 9 |
| Moline | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Springfield | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 18 | 20 |
| Michigan: | | | | | | | | | | | |
| Detroit | 4 | ----- | 0 | 30 | 7 | 52 | 0 | 9 | 1 | 101 | 222 |
| Flint | 0 | ----- | 0 | 7 | 0 | 6 | 0 | 0 | 0 | 1 | 35 |
| Grand Rapids | 0 | ----- | 0 | 2 | 1 | 10 | 0 | 0 | 0 | 1 | 27 |
| Wisconsin: | | | | | | | | | | | |
| Kenosha | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 |
| Madison | 0 | ----- | 0 | 15 | 1 | 1 | 0 | 0 | 0 | 8 | 21 |
| Milwaukee | 0 | ----- | 0 | 1 | 6 | 18 | 0 | 1 | 0 | 24 | 68 |
| Racine | 0 | ----- | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 14 | 18 |
| Superior | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |

City reports for week ended July 1, 1939—Continued

| State and city | Diph- theria cases | Influenza | | Meas- les cases | Pneu- monia deaths | Scar- let fever cases | Small- pox cases | Tuber- culosis deaths | Ty- phoid fever cases | Whoop- ing cough cases | Deaths, all causes |
|--------------------------|--------------------------|-----------|--------|-----------------------|--------------------------|--------------------------------|------------------------|-----------------------------|--------------------------------|---------------------------------|--------------------------|
| | | Cases | Deaths | | | | | | | | |
| Minnesota: | | | | | | | | | | | |
| Duluth..... | 0 | ----- | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 29 |
| Minneapolis..... | 0 | ----- | 0 | 15 | 1 | 1 | 0 | 1 | 0 | 11 | 94 |
| St. Paul..... | 0 | ----- | 0 | 5 | 2 | 3 | 0 | 1 | 1 | 17 | 62 |
| Iowa: | | | | | | | | | | | |
| Cedar Rapids..... | 0 | ----- | ----- | 3 | ----- | 0 | 0 | ----- | 0 | 0 | ----- |
| Davenport..... | 0 | ----- | ----- | 0 | ----- | 0 | 10 | ----- | 0 | 0 | ----- |
| Des Moines..... | 0 | ----- | 0 | 5 | 0 | 3 | 3 | 0 | 6 | 2 | 40 |
| Sioux City..... | 0 | ----- | ----- | 0 | ----- | 1 | 0 | ----- | 0 | 0 | ----- |
| Waterloo..... | 0 | ----- | ----- | 4 | ----- | 0 | 0 | ----- | 0 | 0 | ----- |
| Missouri: | | | | | | | | | | | |
| Kansas City..... | 0 | ----- | 0 | 1 | 1 | 5 | 0 | 7 | 1 | 1 | 90 |
| St. Joseph..... | 1 | ----- | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 30 |
| St. Louis..... | 1 | ----- | 0 | 1 | 4 | 6 | 2 | 5 | 3 | 30 | 215 |
| North Dakota: | | | | | | | | | | | |
| Fargo..... | 0 | ----- | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 2 |
| Grand Forks..... | 0 | ----- | ----- | 0 | ----- | 0 | 0 | ----- | 0 | 0 | ----- |
| Minot..... | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| South Dakota: | | | | | | | | | | | |
| Aberdeen..... | 0 | ----- | ----- | 5 | ----- | 0 | 25 | ----- | 0 | 0 | ----- |
| Sioux Falls..... | 0 | ----- | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 7 |
| Nebraska: | | | | | | | | | | | |
| Lincoln..... | 0 | ----- | ----- | 4 | ----- | 0 | 0 | ----- | 0 | 19 | ----- |
| Omaha..... | 0 | ----- | 0 | 2 | 2 | 1 | 0 | 4 | 0 | 0 | 58 |
| Kansas: | | | | | | | | | | | |
| Lawrence..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 6 |
| Topeka..... | 0 | ----- | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 2 | 9 |
| Wichita..... | 0 | ----- | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 28 |
| Delaware: | | | | | | | | | | | |
| Wilmington..... | 0 | ----- | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 24 |
| Maryland: | | | | | | | | | | | |
| Baltimore..... | 1 | ----- | 0 | 14 | 2 | 3 | 0 | 11 | 0 | 44 | 153 |
| Cumberland..... | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 11 |
| Frederick..... | 0 | ----- | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| District of Col.: | | | | | | | | | | | |
| Washington..... | 4 | ----- | 0 | 77 | 4 | 2 | 0 | 10 | 0 | 29 | 147 |
| Virginia: | | | | | | | | | | | |
| Lynchburg..... | 2 | ----- | 0 | 13 | 2 | 0 | 0 | 1 | 1 | 22 | 11 |
| Norfolk..... | 0 | ----- | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 18 |
| Richmond..... | 0 | ----- | 0 | 22 | 3 | 0 | 0 | 1 | 1 | 0 | 43 |
| Roanoke..... | 0 | ----- | 0 | 0 | ----- | 1 | 0 | 0 | 0 | 0 | 17 |
| West Virginia: | | | | | | | | | | | |
| Charleston..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 8 |
| Huntington..... | 0 | ----- | ----- | 0 | ----- | 0 | 0 | ----- | 0 | 0 | ----- |
| Wheeling..... | 0 | ----- | 0 | 3 | 0 | 1 | 0 | 0 | 1 | 1 | 18 |
| North Carolina: | | | | | | | | | | | |
| Gastonia..... | 0 | ----- | ----- | 0 | ----- | 0 | 0 | ----- | 0 | 0 | ----- |
| Raleigh..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 8 | 16 |
| Wilmington..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 14 |
| Winston-Salem..... | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 18 |
| South Carolina: | | | | | | | | | | | |
| Charleston..... | 0 | ----- | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 27 |
| Florence..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 8 |
| Greenville..... | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| Georgia: | | | | | | | | | | | |
| Atlanta..... | 0 | 3 | 1 | 0 | ----- | 2 | 0 | 3 | 0 | 0 | 84 |
| Brunswick..... | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 |
| Savannah..... | 1 | 2 | 0 | 0 | 8 | 0 | 0 | 1 | 0 | 11 | 30 |
| Florida: | | | | | | | | | | | |
| Miami..... | 0 | 2 | 1 | 0 | 3 | 0 | 0 | 3 | 0 | 3 | 34 |
| Tampa..... | 0 | ----- | 0 | 15 | 0 | 0 | 0 | 1 | 0 | 1 | 20 |
| Kentucky: | | | | | | | | | | | |
| Ashland..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 7 |
| Covington..... | 0 | ----- | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 12 |
| Lexington..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 20 |
| Louisville..... | 1 | ----- | 0 | 1 | 3 | 3 | 0 | 4 | 0 | 14 | 74 |
| Tennessee: | | | | | | | | | | | |
| Knoxville..... | 0 | ----- | 1 | 1 | 2 | 1 | 0 | 2 | 1 | 4 | 30 |
| Memphis..... | 0 | ----- | 0 | 0 | 4 | 4 | 0 | 8 | 2 | 71 | 76 |
| Nashville..... | 0 | ----- | 0 | 1 | 3 | 0 | 0 | 5 | 2 | 11 | 55 |
| Alabama: | | | | | | | | | | | |
| Birmingham..... | 0 | ----- | 0 | 0 | 1 | 0 | 0 | 5 | 0 | 1 | 59 |
| Mobile..... | 0 | ----- | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 15 |
| Montgomery..... | 0 | ----- | ----- | 0 | ----- | 1 | 0 | ----- | 0 | 2 | ----- |

City reports for week ended July 1, 1939—Continued

| State and city | Diph- theria cases | Influenza | | Meas- les cases | Pneu- monia deaths | Scar- let fever cases | Small- pox cases | Tuber- culosis deaths | Ty- phoid fever cases | Whoop- ing cough cases | Deaths, all causes |
|-----------------------|--------------------------|-----------|--------|-----------------------|--------------------------|--------------------------------|------------------------|-----------------------------|--------------------------------|---------------------------------|--------------------------|
| | | Cases | Deaths | | | | | | | | |
| Arkansas: | | | | | | | | | | | |
| Fort Smith..... | 0 | | | 0 | | 0 | 0 | | 0 | 0 | |
| Little Rock..... | 0 | | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 3 |
| Louisiana: | | | | | | | | | | | |
| Lake Charles..... | 1 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| New Orleans..... | 2 | | 0 | 11 | 7 | 4 | 0 | 0 | 2 | 1 | 141 |
| Shreveport..... | 0 | | 0 | 0 | 6 | 0 | 1 | 4 | 3 | 0 | 46 |
| Oklahoma: | | | | | | | | | | | |
| Oklahoma City..... | 0 | 3 | 0 | 0 | 3 | 1 | 0 | 2 | 0 | 0 | 43 |
| Tulsa..... | 0 | | | 1 | | 3 | 1 | | 0 | 0 | |
| Texas: | | | | | | | | | | | |
| Dallas..... | 2 | | 0 | 14 | 1 | 0 | 0 | 1 | 0 | 0 | 57 |
| Fort Worth..... | 0 | | 0 | 5 | 2 | 4 | 0 | 0 | 0 | 0 | 24 |
| Galveston..... | 0 | | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 11 |
| Houston..... | 1 | | 0 | 1 | 7 | 1 | 0 | 3 | 3 | 4 | 77 |
| San Antonio..... | 1 | | 1 | 0 | 2 | 0 | 0 | 7 | 0 | 0 | 64 |
| Montana: | | | | | | | | | | | |
| Billings..... | 0 | | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 13 |
| Great Falls..... | 0 | | 0 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 16 |
| Helena..... | 0 | | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Missoula..... | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 7 |
| Idaho: | | | | | | | | | | | |
| Boise..... | 0 | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 9 |
| Colorado: | | | | | | | | | | | |
| Colorado Springs..... | 0 | | 0 | 0 | 1 | 4 | 0 | 1 | 0 | 1 | 9 |
| Denver..... | 8 | | 0 | 11 | 2 | 6 | 0 | 2 | 0 | 10 | 62 |
| Pueblo..... | 4 | | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 6 | 8 |
| New Mexico: | | | | | | | | | | | |
| Albuquerque..... | 0 | | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 8 |
| Utah: | | | | | | | | | | | |
| Salt Lake City..... | 0 | | 0 | 4 | 2 | 1 | 6 | 0 | 0 | 26 | 39 |
| Washington: | | | | | | | | | | | |
| Seattle..... | 0 | | 0 | 286 | 1 | 1 | 0 | 6 | 0 | 5 | 63 |
| Spokane..... | 0 | | 0 | 21 | 1 | 1 | 0 | 0 | 0 | 0 | 21 |
| Tacoma..... | 0 | | 0 | 9 | 2 | 0 | 0 | 0 | 0 | 0 | 22 |
| Oregon: | | | | | | | | | | | |
| Portland..... | 1 | | 0 | 7 | 2 | 2 | 0 | 2 | 0 | 4 | 69 |
| Salem..... | 0 | | | 5 | | 0 | 0 | | 0 | 0 | |
| California: | | | | | | | | | | | |
| Los Angeles..... | 4 | 6 | 0 | 145 | 6 | 27 | 0 | 19 | 0 | 17 | 262 |
| Sacramento..... | 5 | | 0 | 16 | 0 | 1 | 0 | 1 | 0 | 0 | 20 |
| San Francisco..... | 2 | | 0 | 6 | 3 | 2 | 0 | 8 | 1 | 2 | 130 |

| State and city | Meningitis, meningococcus | | Polio- mye- litis cases | State and city | Meningitis, meningococcus | | Polio- mye- litis cases |
|-----------------|------------------------------|--------|----------------------------------|--------------------|------------------------------|--------|----------------------------------|
| | Cases | Deaths | | | Cases | Deaths | |
| New York: | | | | South Carolina: | | | |
| New York..... | 1 | 0 | 0 | Charleston..... | 0 | 0 | 8 |
| New Jersey: | | | | Georgia: | | | |
| Camden..... | 0 | 0 | 1 | Atlanta..... | 0 | 0 | 1 |
| Ohio: | | | | Tennessee: | | | |
| Cincinnati..... | 1 | 0 | 0 | Nashville..... | 0 | 0 | 1 |
| Michigan: | | | | Arkansas: | | | |
| Detroit..... | 0 | 0 | 1 | Fort Smith..... | 1 | 0 | 0 |
| North Carolina: | | | | California: | | | |
| Wilmington..... | 1 | 0 | 0 | Los Angeles..... | 0 | 0 | 3 |
| | | | | San Francisco..... | 0 | 1 | 0 |

Pellagra.—Cases: Boston, 1; Baltimore, 3; Lynchburg, 1; Atlanta, 1; Savannah, 4; New Orleans, 2; Dallas, 1.

Typhus fever.—Cases: New York, 2; Charleston, S. C., 1; Brunswick, 1; Mobile, 1; Montgomery, 1.—Deaths: Atlanta, 1.

FOREIGN AND INSULAR

CANADA

Provinces—Communicable diseases—Week ended June 17, 1939.—During the week ended June 17, 1939, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

| Disease | Prince Edward Island | Nova Scotia | New Brunswick | Que- bec | On- tario | Mani- toba | Sas- katch- ewan | Alber- ta | British Colum- bia | Total |
|-------------------------------|----------------------------|----------------|------------------|-------------|--------------|---------------|------------------------|--------------|--------------------------|-------|
| Cerebrospinal meningitis | | | 1 | 1 | 2 | | | | | 4 |
| Chickenpox | | 2 | | 77 | 215 | 43 | 15 | 19 | 60 | 431 |
| Diphtheria | | 5 | | 32 | | 3 | | 1 | | 41 |
| Dysentery | | | | 1 | 1 | | | | | 2 |
| Influenza | | 7 | | | 3 | | 1 | | 47 | 58 |
| Lethargic encephalitis | | | | | | | | | 1 | 1 |
| Measles | | 5 | 1 | 754 | 720 | 50 | 14 | 6 | 20 | 1,570 |
| Mumps | | | | 21 | 74 | 35 | | 2 | 9 | 141 |
| Pneumonia | | 3 | | | 18 | | | | 6 | 27 |
| Poliomyelitis | | | | 1 | 1 | | | | | 2 |
| Scarlet fever | | 2 | 16 | 40 | 80 | 15 | 6 | 14 | 9 | 182 |
| Smallpox | | | | | | | 1 | | | 1 |
| Tuberculosis | 3 | 2 | 12 | 88 | 50 | 6 | | 3 | | 164 |
| Typhoid and paratyphoid fever | | 2 | | 15 | 2 | 1 | 1 | 1 | 1 | 23 |
| Whooping cough | | 7 | | 84 | 81 | 9 | 18 | 9 | 51 | 259 |

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for June 30, 1939, pages 1182-1194. A similar cumulative table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Cholera

China.—During the week ended July 1, 1939, cholera was reported in China as follows: Hong Kong, 97 cases; Macao, 95 cases.

Iran—Sistan Region—Zabol.—During the week ended July 1, 1939, 10 cases of cholera were reported in Zabol, Sistan Region, Iran.

Plague

Brazil.—During the month of March 1939, plague was reported in Brazil as follows: Alagoas State, 11 cases, 3 deaths; Bahia State, 1 case; Pernambuco State, 5 cases, 2 deaths.

Peru.—During the month of May 1939, plague was reported in Peru as follows: Lambayeque Department, 1 case; Libertad Department, Trujillo city, 3 cases; Piura Department, 7 cases, 1 death.

Smallpox

Society Islands—Tahiti—Papeete.—During the week ended July 8, 1939, 12 suspected cases of smallpox with 1 death were reported in Papeete, Tahiti, Society Islands.

Yellow Fever

Brazil—Para State—Capanema.—On May 23, 1939, 1 death from the jungle type of yellow fever was reported in Capanema, Para State, Brazil.

Colombia—Department of Antioquia—Caracoli.—On May 29, 1939, 1 death from yellow fever was reported in Caracoli, Department of Antioquia, Colombia.